WINTER 1972

OUR SUN

MAGAZINE OF SUN OIL COMPANY

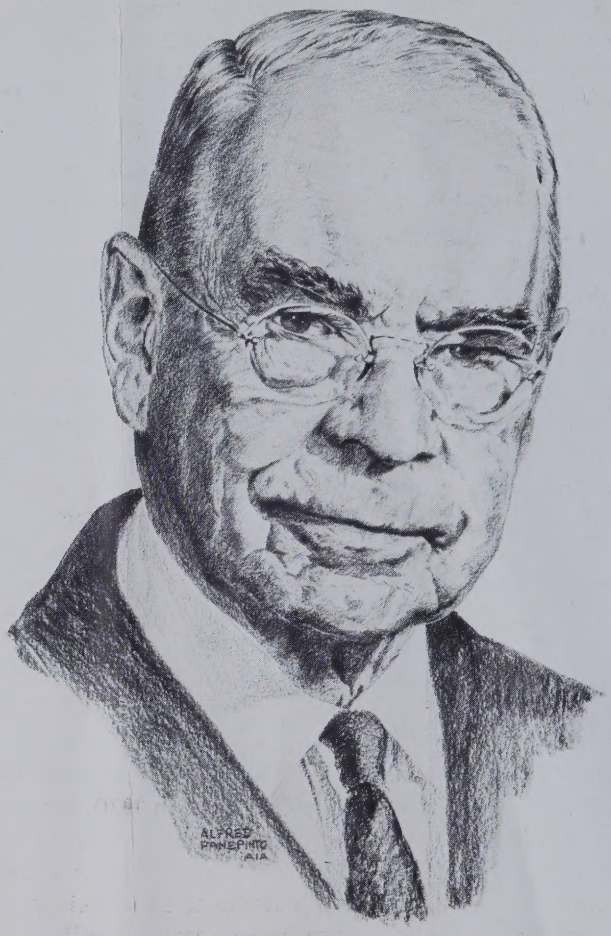
Sun's Chairman Speaks Out

ON OIL IMPORTS

Uncovering the Ocean's Secrets

A New Chance For Whales

Out on the Ice
With Sun's Explorers
In Canada's Arctic



J. HOWARD PEW 1882-1971

"I CAME TO RESPECT HIS ADVICE AND counsel, and to love him almost as a father."

These words, spoken by evangelist Billy Graham about J. Howard Pew, sum up the feelings of many people about the man who devoted a lifetime to Sun Oil Company.

First as an engineer in the company that his father founded in 1886, later as a refinery superintendent, vice-president, president, board chairman, and chairman of the executive committee, Mr. Pew guided Sun Oil Company in its growth from a small, regional firm to one of the largest energy companies in the country.

As Sun grew, fewer employees had the opportunity to meet him personally or to hear him speak. But the remembrances of long-service employees paint a portrait of a truly remarkable man.

Integrity, conviction, discipline, and *humility* are words that come up often in the conversations of those who knew and worked with him.

He has been described as a quiet, modest man who cherished privacy. But at the same time he was dynamic, and when he became involved in a problem, his involvement was complete.

"He often gave the impression of aloofness, but I came to realize that it was shyness," an acquaintance recalls. "It was just not his nature to seek attention, or to push himself into situations."

He gave the impression, too, of sternness. But he was a story-teller, and his deep laugh was infectious.

He tested people with questions, but when he decided to support someone, he stood behind him 100 per cent.

It was his habit in meetings to withhold his own views until he had drawn out those of others. He was concerned that others might think he had already reached a decision if he expressed himself first and that they, therefore, might not give him the benefit of their true thoughts. He would probe all sides of a question carefully before committing himself, but once committed, he rarely changed.

For a man of substantial means, he did not live lavishly. His home and grounds could properly be called an estate, but they were not pretentious, and he spent little on himself.

It is widely known that Mr. Pew did

Sun Oil Company 1970

Sun Oil Company 1970 Annual Report

Liquid loading facility services two new Sun-operated natural gas processing plants at Lake Maracaibo, Venezuela.

Financial and Operating Highlights

Financial	1970	1969
Revenues	$1,961,966,000	$1,858,839,000
Net Income	$139,075,000	$153,551,000
Per Share After Preferred Cash Dividends	$3.19	$3.74
Per Share Assuming Conversion of Preferred	$3.11	$3.48
Cash Dividends on Preferred	$40,994,000	$41,602,000
Cash Dividends on Common	$28,922,000	$26,926,000
Stock Dividend on Common	5%	6%
Capital Expenditures and Intangible Development Costs	$368,082,000	$302,435,000
Total Assets	$2,766,722,000	$2,476,523,000
Operating		
Net Crude Production (b/d)		
U.S. and Canada	229,248	219,626
Other	134,049	133,519
Net Wells Completed	295	381
Synthetic Crude-Net Produced for Shipment (b/d)	32,740	27,336
Natural Gas Sales (mil. cu. ft./d)	1,441	1,571
Crude Refined (b/d)		
By Sun Refineries	463,356	466,642
For Sun's Account-Venezuela	22,050	22,241
Refined Product Sales (b/d)	553,264	550,948

Contents

Letter to Stockholders, Employees 1

Operations Report 3

Financial Review 13

Financial and Statistical Section 14

On the Cover:
Recreation continues to thrive at Santa Barbara, Calif., unimpeded by Sun's offshore drilling platform. Designed specifically for the site with full consideration of wind, wave and earthquake conditions, it contains a wide array of safety and anti-pollution devices. Included is a "fail-safe" system which automatically shuts down operations in the event of emergency.

To the Stockholders and Employees of Sun Oil Company:

Last year, following Sun's reorganization, we said we looked forward to 1970 as a year of action in implementing our merger plans and moving toward new financial and operating goals.

We are pleased to say that implementation of the Sun-Sunray DX merger is on schedule. And, our new corporate structure is functioning successfully.

Management has already taken steps that will capture approximately half of the $60 million in annual pre-tax savings we estimated could be achieved by 1973 through reorganization of the Company. Though the impact of these actions was offset in 1970 by one-time merger-related expenses, their impact will continue and the remainder of the $60 million will be achieved.

The tempo of the U.S. economy has undergone marked change since our merger in October, 1968. Profits of U.S. companies fell some 14 per cent between the final quarter of that year and the final quarter of 1970. For the petroleum industry, higher operating costs were accompanied by a sharp rise in taxes. We said a year ago that the combination might necessitate higher prices.

Gasoline prices did rise three times during 1970, but the first two increases eroded rapidly. The final increase occurred in November, too late to compensate for the steady rise in our costs.

Failure of prices to cover costs, increased income taxes and continuing, although reduced, losses by Great Canadian Oil Sands Limited accounted for our 1970 earnings decline. However, we are encouraged that the November gasoline price increase, which accompanied an advance of 25 cents per barrel in U.S. crude oil prices, was netting a higher return. Also encouraging are signs that prices more nearly reflecting the intrinsic value of natural gas may soon be permitted.

Although earnings were unsatisfactory, several areas of Company operations showed substantial progress. Our crude oil and condensate production set new volume records. Our revenues increased more than $100 million. And the merits of the blending pump system of gasoline marketing were reaffirmed in 1970, as Sunoco 260 total volume increased almost 12 per cent.

Direct capital investments and intangible development costs in 1970 exceeded our projection of $250 million a year ago. The increase resulted from our decision to finance the new Puerto Rico refinery by direct investment.

As you well know, mechanical difficulties of GCOS have constituted one of our most vexing problems over the past few years. Now we are pleased to report that since late December, and for the first time under deep winter conditions, the project has averaged production rates essentially equal to its authorized capacity. A general crude oil price increase of 25 cents per barrel, effective in December, should have a material effect on our 1971 revenues from synthetic crude.

The precarious balance of energy supply and demand in the U.S. is becoming clear to more people. The country is awakening to the fact that although there is not yet a lack of potential U.S. resources, the reserve capacity to offset imports in emergencies has vanished in the cost-price squeeze that has discouraged exploration and development in recent years.

Meanwhile, decisions by the governments of oil-exporting nations to take a larger share of revenues from petroleum operations are raising the cost of foreign supplies. For these reasons and others, including the valid determination to reduce adverse environmental consequences of power generation, the days of cheap energy in the U.S. appear to be numbered.

Renewed disruptions last year again emphasized the folly of permitting the U.S. to become dependent upon unstable foreign energy sources. The need is great for a national policy encouraging the fullest development of the country's total energy resources.

The year 1970 was one of large-scale change within Sun Oil Company. While the changes provided additional competitive strength, they required at the same time a special kind of fortitude on the part of our employees and many of their families. We are especially grateful to them, and extend our appreciation also to our stockholders, customers, distributors and dealers for their loyal support.

J. Howard Rew
Chairman of Executive Committee

Robert G. Dunlop
Chairman of the Board

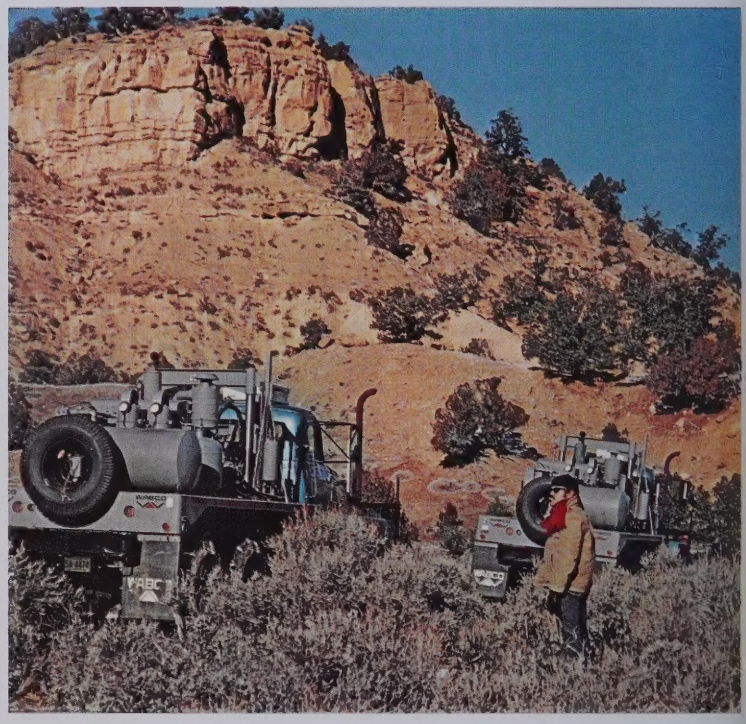
R. Robert Shaughnessy
President

Philadelphia, Pa.
February 23, 1971

Seafood and petroleum industries coexist harmoniously in Gulf of Mexico. Sun was cited by Louisiana shrimpers' association for its cooperation.

Exploration party operates near Bryce Canyon, Utah. Hydraulic vibrating techniques are used instead of explosives, thus preserving environment.

Women gather potatoes on 1,000-acre farm adjacent to natural gas plant at Bacton, Norfolk, England, in which Sun has an interest.



Winter sports enthusiasts pause in Sun's gas field at Divide Creek, Colo., scene of world's highest natural gas well.

Game remains plentiful in desolate south Texas area where Sun is developing new Big Wells Field.

Our natural environment was of major concern to every responsible citizen in 1970; it was thus of similar concern to Sun Oil Company as a corporate citizen.

Ecology is often associated with pollution control, and many of the Company's anti-pollution activities are covered in this Report. However, Sun recognizes that the word has a wider definition, which includes the total relationship between people or organizations and their environment.

In this broad sense, Sun functions not only within the business world, but within the total environment of society. While the Company is primarily an economic organization, it is a social institution as well.

It recognizes that its long-run economic interests—and those of its customers, employees, stockholders, dealers and distributors—are closely related to the welfare of society.

Profit, Social Responsibility

Sun understands that its profit-making responsibility must be pursued with a sense of social responsibility. In striving to operate as a good corporate citizen, it has found these two elements not only compatible, but so intertwined that they are largely inseparable.

Exploration and Production activities offer a good example. In one sense, these operations provide the raw materials that Sun processes and markets to earn a profit. In another sense, however, they enable the Company to meet a social responsibility: helping to satisfy the enormous demand for energy.

In 1970, Sun's production of crude oil and condensate on the North American Continent, including discoveries and acquisitions, rose 4 per cent to total 229,248 barrels a day. Natural gas sales, however, dropped 9 per cent to 1,420 million cubic feet a day.

The Company's increased exploration emphasis on high potential, high risk areas was demonstrated late in 1970 by an agreement giving Sun working interests ranging from 13.5 to 25 per cent on 27.2 million acres in the Canadian Arctic Islands. Testing of this acreage has started, with drilling under way on Melville and Bathurst Islands, where Sun is operator. The Company now has interests in about 35 million widely distributed acres in the Arctic Islands.

Far North Key Future Area

Extensive geological and geophysical surveys were conducted in 1970 by Sun as operator for a five-company group exploring in the Gulf of Alaska. A two-man "Guppy" submarine, manufactured by Sun Shipbuilding & Dry Dock Company, participated successfully. Long-range plans call for continued intensive exploration in the Far North and other key areas, including the oceans adjacent to North America.

At the same time, Sun will continue selective exploration of the continental United States. Acquisition of interests in nine tracts off the coast of western Louisiana in December opens new exploratory drilling opportunities for the 1970s. Sun is operator there for a five-company group.

Active drilling programs in 1970 contributed to reserves and to production from south Texas to northwestern Alberta, and from south Florida to Tract 401 in the Santa Barbara Channel. By year end, the Big Wells Field in Texas had a total of 64 wells

Oil well operates in midst of lemon orchard, near Oxnard, Calif.

completed, the new West Felda Field in Florida had 10, and Tract 401 had 17. All three of these fields, with Sun as operator, were contributing significantly to the Company's production totals.

Sun was busy on many fronts during the year in international operations. In Venezuela, two natural gas processing plants came on stream at Lake Maracaibo, with Sun as operator. Located offshore, the Lama compression and extraction plant is capable of processing 150 million cubic feet of gas per day. Onshore, the Bajo Grande fractionating plant has a processing capacity of 26,000 barrels a day.

Sun's share of crude oil production from Venezuela averaged 112,239 barrels a day, mainly from two Sun-operated blocks in the lake.

Elsewhere in South America, Sun participated in drilling two dry exploratory wells off Colombia's Guajira Peninsula. In Argentina, Sun is part of a four-company group drilling an exploratory well in Mendoza Province; at least two other wells are planned for 1971.

Middle East Operations

Iranian Sun Oil Company lifted an average of 32,504 barrels a day of crude oil from the Sassan Field, which included its 12.5 per cent share of production. Sun's share from Dubai's Fateh Field during its first full year of production averaged 3,987 barrels a day. Arabian Sun is operator for a joint venture which received a 6.2 million acre concession on the west coast of Saudi Arabia and in the Red Sea. Exploratory drilling is scheduled to begin during 1971.

In Europe, North Sea Sun acquired interests in two new British North Sea licenses and will be operator in one of these areas. Drilling will start this year. A three-company group, in which Sun has a 45 per cent interest, was awarded a block on the North Sea continental shelf off the Netherlands. Average daily gas production rose impressively to 250 million cubic feet at the North Sea's Hewett Field, in which Sun has a 10.7 per cent interest.

In Mozambique, Sun, as operator for a three-company group, completed six dry exploratory wells offshore. A seventh well, onshore, is being drilled and one more is planned for 1971.

Research and development for Sun's exploration and production effort focused on keeping technology for deep water and Arctic regions abreast of the pace of the Company's acquisitions; improving recovery, and reducing cost, on producing properties already operated by Sun; and extending the value of information obtained through seismic surveys and data processing.

Sun is also pursuing other energy sources. Its subsidiary, Cordero Mining Company, continued acquisition and development of coal reserves as a future source of liquid hydrocarbons. It is also exploring for other energy resources such as uranium and natural steam.

GCOS Shows Production Increase

In 1970, Great Canadian Oil Sands Limited produced for shipment 11,950,000 barrels of synthetic crude, or 32,740 barrels a day, a 20 per cent gain over 1969.

Financially, the tar sand facility in Alberta operated at a loss,

Sun's refinery near Monrovia, Liberia—country's first such facility—produces fuels, oils, asphalt and other products for Liberia's needs, as well as for export.

due chiefly to below-capacity production and other problems. However, revenues were up and Sun's portion of the loss was reduced.

A second conveyor system was installed which increased mining capability by about 20 per cent in 1970. Extensive modifications of the main boilers were completed and their operation in recent months has been generally satisfactory.

Numerous difficulties which previously limited the processing area of the plant are believed to be resolved, and it is now capable of sustained operation at above-authorized rates. To achieve greater flexibility, additional pumping equipment was installed to increase the designed capacity of the Fort McMurray-to-Edmonton pipeline from 57,000 to 68,000 barrels of synthetic crude daily.

During the year, GCOS began direct operation of its dike building program resulting in substantial economic benefits. A comprehensive program for improving overburden removal was adopted which promises to lower unit costs. To achieve these savings, the Company is investing $10 million for overburden removal equipment. A building is under construction that will provide facilities for maintenance and service of transportation equipment.

Low-lead gasoline, intended to reduce air pollution, is being test-marketed in the Richmond, Va., area.

Manufacturing Improves Air, Water Controls

Highlights of Sun's intensified efforts in 1970 to improve refinery pollution control included the first stage of a multi-million dollar water treatment project at Marcus Hook, Pa.; completion of the fourth stage of a waste-water treatment project at Toledo, Ohio; and a $50,000 project to improve air and water pollution controls at Sarnia, Ont. Other environmental projects at Toledo included a new cooling tower to reduce water effluent temperatures, and a new flare stack to reduce smoke. At Corpus Christi, Tex., all flare stacks were converted to smoke-free operation and waste water quality was improved by additional separator capacity.

In early August, Hurricane Celia shut down the Corpus Christi refinery for more than two weeks. Despite severe personal hardships, employees did a magnificent job of getting the refinery back on stream in record time. Sun provided an interest-free loan program, housing and other assistance to employees.

During 1970, Sun integrated former DX and Sunoco manufacturing operations into a single smooth network through coordination and planning. This will improve utilization of the refineries and reduce net costs, while maintaining high product quality.

Progress in Puerto Rico

Sun's construction of a major refining complex at Yabucoa, Puerto Rico, is essentially on schedule, with the first stage—a crude oil unit—coming on stream in the next few months. The second unit—a lubricating oil plant—is scheduled for completion by the end of 1971.

This $125 million refinery, which will process 66,000 barrels a day of crude, will have one of the world's most efficient environmental control programs. More than 10 per cent of the total project cost has been allocated for this purpose.

Sun has acted to see that the refinery will be staffed primarily

Artist makes rendering of Sunoco service station under consideration. Designs are evaluated for compatibility with surroundings.

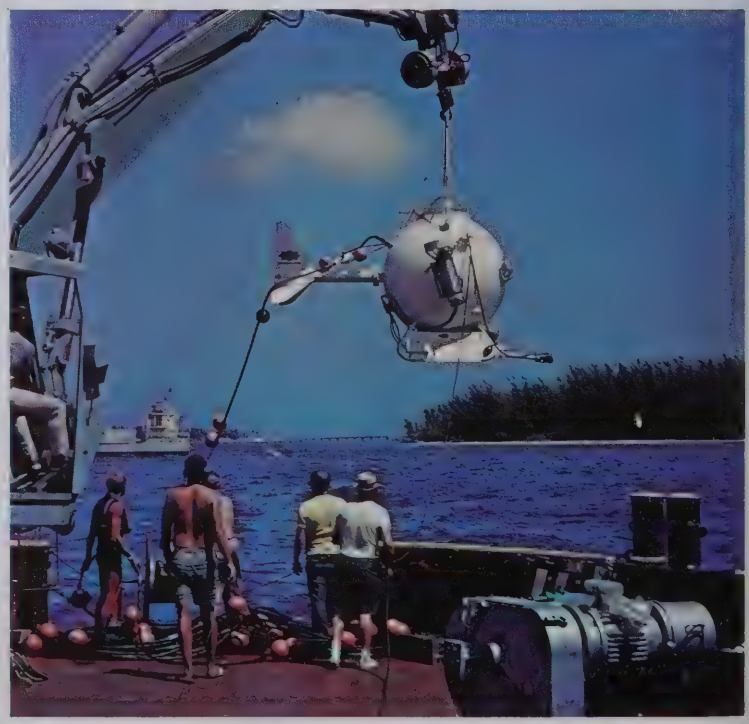
Newly acquired outlet in Rockford, Ill., accepts delivery of Sunoco Custom Blending pump.

Distributor in Oslo, Norway, pauses enroute to deliver lubricating oils.

Researcher forms plastic thread to test quality of Sun petrochemicals, which ultimately may be used for new fabrics.

The M.S. Southern Sun, *newest and largest tanker in Sun service, is equipped with such pollution control devices as a sewage disposal system and clean ballast tanks.*

Sun Shipbuilding & Dry Dock Company entered the commercial submersible field in 1970 with its two-man "Guppy."



Mid-Valley Pipeline Company operates compatibly with environment. Affluent housing development is being constructed adjacent to right-of-way in Longview, Tex.

Members of Environmental Conservation Staff meet to discuss corporate planning for matters of ecology.

with residents of the Yabucoa area, where unemployment currently runs high. Training programs for skilled jobs have been started. Outside the refinery, Sun representatives are working with island officials in other community efforts.

Late in 1970, Sun concluded that a proposed large olefins complex at Marcus Hook would not be feasible at present. The preliminary cost projection of $100 million for this petrochemical plant rose over a short period to more than $125 million. The anticipated return on investment no longer met Sun's criteria for a project of this nature.

Petrochemicals Activities

A Petrochemicals Division was established in 1970 to serve Sun on a domestic and international basis. At Corpus Christi, both cumene and styrene capacities were increased, while at Marcus Hook, the capacity of the aromatics extraction unit was expanded.

The Company is concentrating a portion of its research and development effort on additional petrochemicals opportunities.

Sun's current petrochemical output finds its way principally into plastics and synthetic fibers. Both industries experienced problems last year due to tight money, lower automobile production and decreased housing starts. Current projections are that these two industries will continue to have problems in 1971.

SunOlin Chemical Company (50 per cent owned by Sun) reported lower profits for 1970. Periodic feedstock shortages and substantially increased fuel costs were major factors. A new hydrogen-producing facility is slated for full operation in 1971.

Red Barn Chemicals, Inc. cut its operating losses through expansions in cattle feed products and agent sales, and elimination of its grain operation. The subsidiary converted most of its retail outlets from Company-operated service centers to independent dealer operations. Feed product sales were boosted by the addition of 60 new dealers.

Sun Ship Has Busy Year

Sun Shipbuilding & Dry Dock Company continued at a high level of operations in 1970. The shipyard delivered three vessels: a fully containerized cargo ship, an 80,000 deadweight-ton tanker, and a roll-on/roll-off trailership. Work is under way on another containership, a 126,000 deadweight-ton tanker and two 80,000 deadweight-ton tankers.

During the year Sun Pipe Line Company relocated its headquarters to Tulsa, Okla., and established regional offices in King of Prussia, Pa., and Longview, Tex. Considerable cost reductions are anticipated from this consolidation of manpower and facilities. Sun also acquired 431 miles of gathering and trunk lines in south Texas in 1970.

Sun's transportation activities during 1970 saw the christening of the *M.S. Southern Sun,* a 97,000 deadweight-ton tanker, launched in Spain. The vessel transports crude between the Persian Gulf and ports in Western Europe and North America, under German registry. As with the ocean-going fleet operated by Sun, it incorporates a highly sophisticated pollution abatement system.

Product distribution was further improved with the addition of two large sea-going tugboats and three barges (capacities:

115,000, 60,000 and 25,000 barrels) in 1970. Two barges are scheduled in 1971.

Sun's Marketing Division in 1970 effectively demonstrated how public and private objectives can coincide. Sales by Interstate highway stations were up 22 per cent, in a year when station beautification was aggressively promoted and accomplished. The program, an ongoing effort, has won more awards and favorable public comment than any in Sun's marketing history.

Marketing continued its program of upgrading the appearance of service stations and bulk plants. Also, pollution control devices, transfer pipes, storage and station tanks are checked frequently to prevent leakage.

Retail marketing penetration increased significantly in Illinois and in St. Louis, Mo., with the addition of more than 400 stations in these areas.

Researcher uses electron microscope to analyze hydraulic oil, which is soap-thickened to reduce pollution potential from leakage.

Philadelphia employees tutor student at predominantly black high school, as part of program involving regular visits by Sun volunteers.

Reduced-Lead Fuels Introduced

In response to mounting public concern over automobile emissions, a new low-lead gasoline called SunLite is being test-marketed in the Richmond, Va., area.

Also during 1970, reduced-lead gasolines were introduced in western and central Ontario by Sun Oil Company Limited. This Canadian subsidiary reported 1970 profit gains, largely due to increased product sales and improved product prices.

Composition and specifications for the Company's low-lead gasolines were designed to maintain proper engine performance at the octane quality levels suggested for many 1971 cars. Participation in the Inter-Industry Emissions Control cooperative program continues to aid Sun in the development of low-emission fuels. The Company is planning to meet its requirements for the additional higher-octane hydrocarbons needed in unleaded gasolines.

Sales of Sun's refined products again reached record levels. Contributing to the increase was Sun's expansion as a major supplier to the transportation industry. Many of the nation's largest commercial fleets now use Sunfleet engine oils.

Sales to the automotive industry hit new heights. In 1970, nearly one of every three cars coming off the assembly lines contained Sun motor oils, automatic-transmission fluids, wheel-bearing grease or shock-absorber fluid.

Sun's three European subsidiaries, their distributors and an affiliated company in Japan made further gains in the marketing of industrial lubricants. Refrigeration and rubber process oils once again provided the main increases.

The environmental effects of Sun's industrial products and automotive lubricants are being carefully studied and products reformulated as necessary to avoid potential pollution problems.

Lube Program Controls Costs

The Company's Computerized Lubrication Control Program, which uses computer techniques to aid industrial customers in controlling costs, gained wide acceptance. By year end, approximately 70 major manufacturers took advantage of the program.

Plans were completed for centralizing Company credit card operations by relocating the Sunoco brand portion of the operation from Wayne, Pa., to Tulsa. Sunoco's agreements with selected motels were also extended to the DX brand marketing area.

Board of Directors' Executive Committee, the men primarily concerned with Sun's social and economic responsibilities, are from left to right, front: H. Robert Sharbaugh, J. Howard Pew, Robert G. Dunlop. Rear: Robert W. Donahue, Darwin W. Ferguson, R. Edwin Foss, Donald P. Jones.

Outside credit card affiliations were also expanded, with Sunoco brand now joining DX brand in honoring Master Charge and BankAmericard, and both adding American Express for the first time. Substantial revenues from these new sources are projected.

Valuable public exposure, as well as keeping up with the requirements of modern automotive technology, again led Sun to participate in its racing program with Roger Penske. Driver Mark Donohue finished second at the Indianapolis 500 in the Sunoco Special, while the Sunoco Javelin also finished second in the Trans-Am races.

Retail products continued to be advertised through television, radio and newspaper, with the emphasis on sports-oriented broadcast sponsorship. More than 45 new television commercials were created during the year.

Profit, Social Projects Pursued

Sun's commitment to preserve and improve the environment guided many efforts of the Research and Development Division in 1970.

A computer program named STACK, which calculates pollutant concentration, was developed and offered without charge to governmental agencies and non-profit organizations to aid them in air-quality control.

In the reorganization of the R&D Division, a separate department has been established to work on future technical opportunities and problems, and to provide new profit opportunities.

Sun continued to operate on the principle that manpower is an important resource among the tangible assets of the Company, which can grow in value through careful development.

A major goal in 1970 was to implement the merger efficiently while maintaining good employee and public relations. Separation programs and liberalized early retirement benefits were utilized.

An improved employee benefit program was instituted at the beginning of 1970, at an increased annual cost of $2.5 million.

Community Participation

Sun continued to demonstrate concern for minority groups, as stated by President H. Robert Sharbaugh, "... through active recruitment for employment, developmental programs for promotion, and participation in community affairs."

Money, equipment and professional expertise have been provided to five predominantly black colleges under the National Alliance of Businessmen Cluster Program. Scholarships have also been given within the National Merit Achievement Scholarship Program and fellowships have been established in graduate schools of business.

During 1970, Sun's service station attendant program in Philadelphia, under the NAB Jobs Program for the disadvantaged, paid and trained young men for possible employment by dealers. Secretarial training for unemployed or underemployed young women has been undertaken in Philadelphia, Tulsa and Dallas.

Money, material and services have been contributed to Opportunities Industrialization Centers (OIC), Urban Leagues, Model Cities, Urban Coalitions, and many other innovative community efforts.

Sun Oil Company's Role As a Corporate Citizen

In 1970, Sun's five U.S. refineries produced enough petroleum products to meet the annual needs of 6½ million Americans.

Providing those products and others, such as ships and natural gas, required the skills and efforts of over 28,000 men and women, working with the resources of a $2.8 billion corporation.

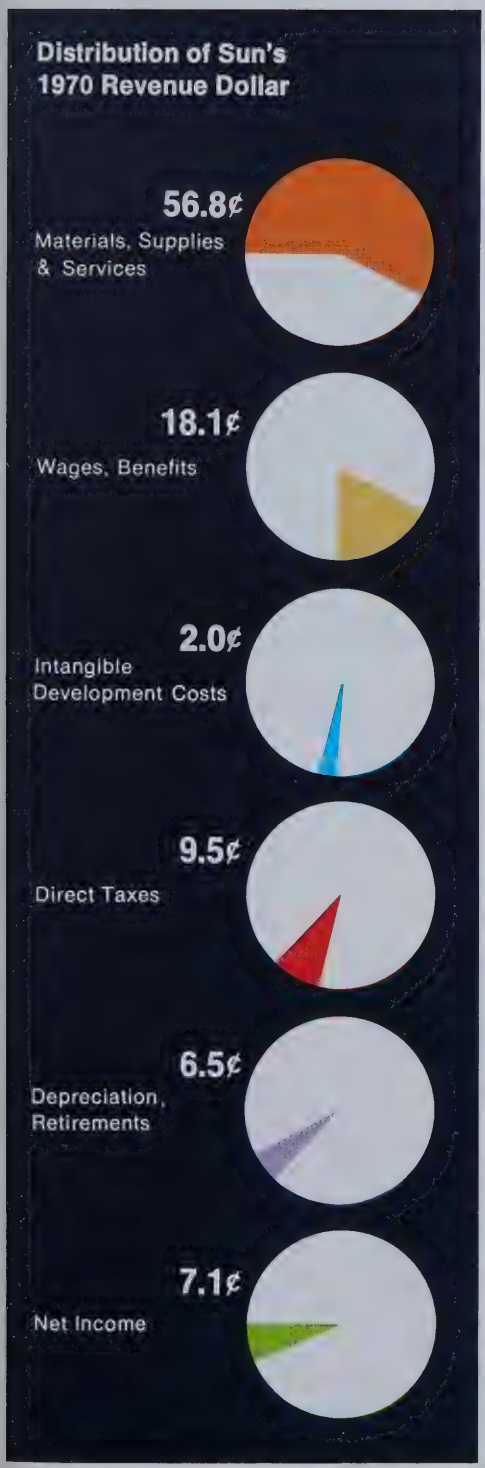
Who Benefited?

Employees
Sun's wage and benefit payments exceeded $350 million. Among the benefits: a stock purchase plan, one-third Company financed, in which 15,500 employees are currently participating.

Stockholders
Sun paid cash and stock dividends valued at more than $130 million to more than 130,000 stockholders.

Governments
The Company's direct tax obligations to federal, state and local governments exceeded $185 million. In addition, Sun collected from customers and turned over to these governments more than $430 million in gasoline and other excise taxes.

Other Businesses
Sun bought more than $1 billion in materials, supplies and services from over 100,000 large and small U.S. suppliers.



Sun Oil Company and consolidated subsidiaries earned $139,075,000 in 1970, 9.4 per cent less than the 1969 restated net income of $153,551,000.

The adjustment upward from the reported 1969 net income of $152,260,000 reflects a change in the method of accounting for non-producing leaseholds.

Earnings Per Share $3.11

Assuming conversion of all preferred shares, 1970 earnings were equal to $3.11 per common share, compared with $3.48 in 1969.

The per share computations are based on the weighted average number of shares outstanding during each year, adjusted for stock dividends. The adjusted average number of common shares outstanding was 30,765,707 in 1970 and 29,947,932 in 1969 which, assuming full conversion of all preferred shares, averaged 44,704,594 for 1970 and 44,112,152 for 1969.

Revenues rose 5.5 per cent to $1,961,966,000 from $1,858,839,000.

The impact of inflation, higher tax liabilities and continuing losses at Great Canadian Oil Sands Limited is reflected in an increase in total costs and expenses that outstripped the rise in revenues.

Total costs and expenses rose 6.9 per cent in 1970 to reach a record $1,822,891,000.

Tax Burden Increases

Taxes paid or accrued, including $84,011,000 in foreign, federal and other domestic income taxes, climbed to $185,614,000. The Company also collected $489,724,000 in taxes from customers and employees for payment to various governments.

Sun increased its interest in GCOS to 96.1 per cent in 1970. The Company's share of the losses sustained by that operation during the year declined to $14,768,000.

During the year, Sun paid to common and preferred shareholders cash dividends totaling $69,916,000. In addition, a 5 per cent stock dividend to common shareholders accounted for the distribution in December of 1,477,418 shares and a transfer of $63,529,000 from earnings employed in the business to the capital account.

Modernization Continues

Capital expenditures and intangible development costs totaled $368,082,000 in 1970 as the Company continued to expand and modernize its physical facilities. Almost 97 per cent of that amount was spent on activities in the U.S., Puerto Rico and Canada.

Comparable direct Company expenditures planned for 1971 are $371,000,000.

During the year the Company purchased for retirement 673,130 shares of preferred stock. Including the 5 per cent dividend of 1,477,418 shares, common stock issued for acquisitions, pension fund and other business purposes resulted in a net increase of 2,544,810 common shares issued.

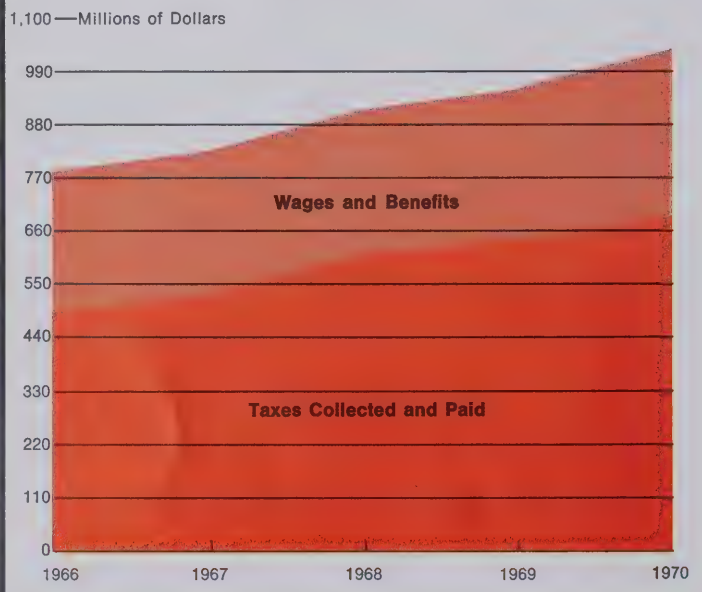
Debentures, Notes Sold

In November, the Company sold $150,000,000 in 8.5 per cent debentures due November 15, 2000, and $50,000,000 in 7.75 per cent notes due November 15, 1976. These funds were obtained for the purpose of repaying a substantial part of the Company's short term debt, for capital expenditures and other corporate purposes.

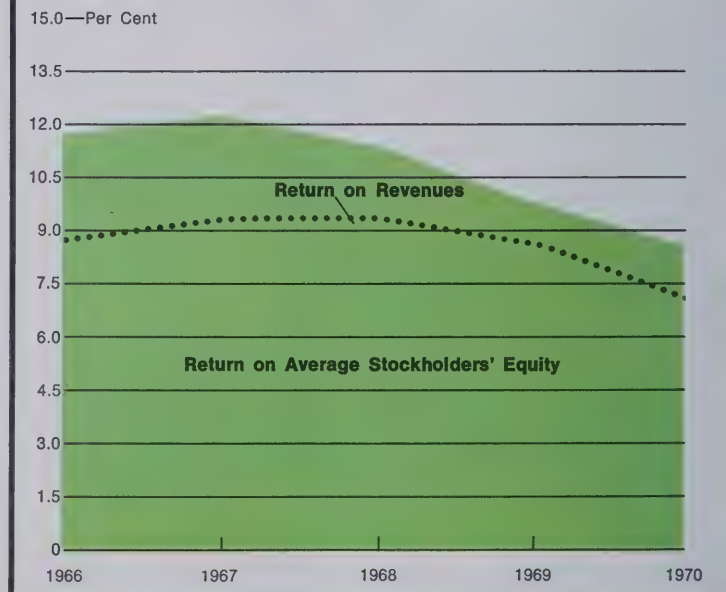
The addition of this debt resulted in $512,116,000 in long term debt at year end. The weighted average annual interest rate on this debt is 6.3 per cent.

The Company's total assets, located principally in the U.S., Puerto Rico and Canada, rose to $2,766,722,000 in 1970.

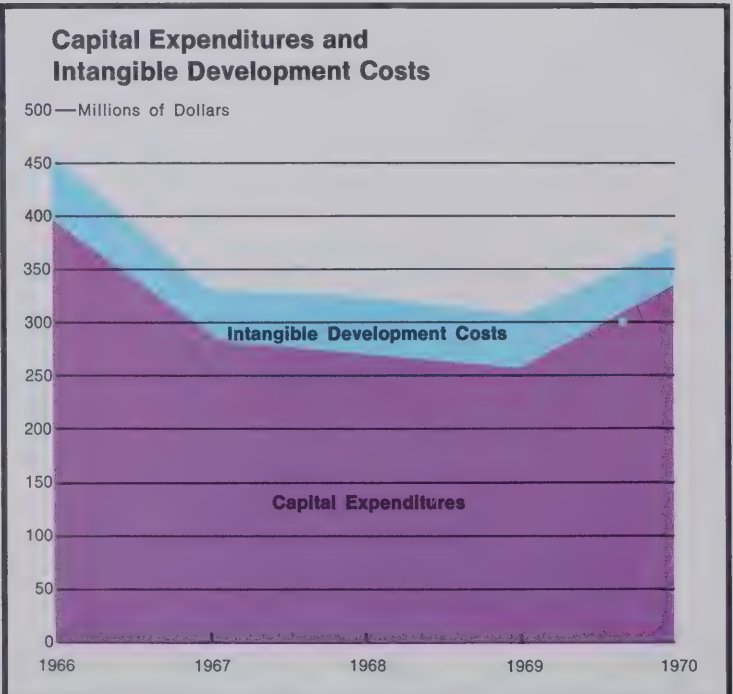
Taxes, Wages and Benefits



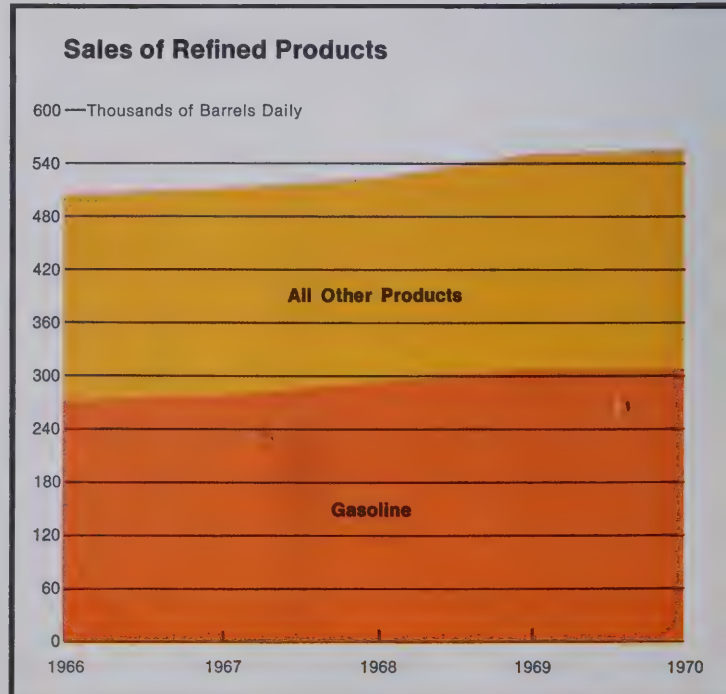
Return on Revenues and Average Stockholders' Equity



Capital Expenditures and Intangible Development Costs



Sales of Refined Products



Consolidated Statement of Income and Earnings Employed in the Business

For the Years Ended December 31	1970	1969*
Revenues		
Sales and Other Operating Income	$1,941,906,000	$1,837,757,000
Other Income	20,060,000	21,082,000
	1,961,966,000	1,858,839,000
Costs and Expenses		
Costs and Operating Expenses	1,178,908,000	1,108,157,000
Selling, General and Administrative Expenses	263,115,000	232,435,000
Taxes, including Income Taxes	185,614,000	173,924,000
Intangible Development Costs	39,247,000	47,304,000
Depreciation, Cost Depletion, Amortization and Retirements	127,831,000	117,486,000
Interest and Debt Expense	28,847,000	26,004,000
Minority Interest	(671,000)	(22,000)
	1,822,891,000	1,705,288,000
Net Income	139,075,000	153,551,000
Earnings Employed in the Business at January 1	380,156,000	411,266,000
Adjustment to reflect change in method of accounting for non-producing leaseholds	—	(31,217,000)
Adjustment for poolings of interests	8,227,000	—
Earnings Employed in the Business at January 1, as Restated	388,383,000	380,049,000
Dividends Paid		
Cash		
Preferred Stock	40,994,000	41,602,000
Common Stock	28,922,000	26,926,000
Common Stock		
1970–5%–1,477,418 Shares	63,529,000	
1969–6%–1,633,003 Shares		84,916,000
	133,445,000	153,444,000
Earnings Employed in the Business at December 31	$ 394,013,000	$ 380,156,000
Net Income per Common Share (Based on weighted average number of shares outstanding during each year, adjusted for stock dividends):		
After provision for cash dividends on preferred stock	$3.19	$3.74
Assuming full conversion of all preferred shares	$3.11	$3.48

*Restated

(See Accompanying Notes)

Consolidated Statement of Financial Position

Assets at December 31	1970	1969*
Current Assets		
Cash	$ 58,904,000	$ 66,002,000
Short Term Investments, at cost	34,218,000	35,448,000
Accounts and Notes Receivable	373,602,000	321,936,000
Crude Oil and Refined Products	173,543,000	165,751,000
Materials and Supplies	40,835,000	31,909,000
Work in Process	18,834,000	10,894,000
Total Current Assets	699,936,000	631,940,000
Long Term Receivables and Investments		
Accounts and Notes Receivable	56,391,000	90,709,000
Investment in Affiliated and Unconsolidated Companies	52,961,000	24,325,000
Other Investments, at cost	14,866,000	13,854,000
	124,218,000	128,888,000
Properties, Plants and Equipment		
Production	1,135,660,000	1,051,991,000
Manufacturing	739,884,000	653,090,000
Marketing	717,152,000	634,684,000
Transportation	223,280,000	210,870,000
Mining	254,364,000	248,285,000
Shipyard	42,508,000	39,368,000
Administrative and Others	23,615,000	20,846,000
Total, at cost	3,136,463,000	2,859,134,000
Less Depreciation, Cost Depletion and Amortization	1,322,753,000	1,234,550,000
	1,813,710,000	1,624,584,000
Prepaid and Deferred Charges		
Pension Costs	80,152,000	56,348,000
Excess of Cost of Investments in Subsidiaries over Equities in Net Assets Acquired	16,139,000	6,229,000
Other	32,567,000	28,534,000
	128,858,000	91,111,000
Total Assets	$2,766,722,000	$2,476,523,000

*Restated

(See Accompanying Notes)

Liabilities and Stockholders' Equity at December 31	1970	1969*
Current Liabilities		
Accounts Payable and Accrued Liabilities	$ 247,293,000	$ 185,447,000
Notes and Bonds Payable	46,770,000	63,634,000
Taxes, other than Income Taxes	47,729,000	43,050,000
Income Taxes	73,272,000	45,378,000
Total Current Liabilities	415,064,000	337,509,000
Long Term Debt	512,116,000	402,932,000
Deferred Credits		
Income Taxes	128,554,000	99,166,000
Sales of Properties and Future Oil Production	19,632,000	26,357,000
Other	26,628,000	23,382,000
	174,814,000	148,905,000
Minority Interest	3,466,000	1,802,000
Stockholders' Equity		
Preferred Stock, $2.25 cumulative convertible		
Authorized –18,582,518 shares		
Issued, 1970–17,815,951 shares stated value $52 per share	926,429,000	
Issued, 1969–18,491,013 shares stated value $5 per share		92,455,000
Common Stock, par value $1 per share		
Authorized –100,000,000 shares		
Issued, 1970–31,396,222 shares	31,396,000	
Issued, 1969–28,851,412 shares		28,851,000
Capital in Excess of Par or Stated Value	328,736,000	1,098,024,000
Earnings Employed in the Business	394,013,000	380,156,000
	1,680,574,000	1,599,486,000
Less Common Stock Held in Treasury, at cost		
1970–422,931 shares	19,312,000	
1969–266,837 shares		14,111,000
Total Stockholders' Equity	1,661,262,000	1,585,375,000
Total Liabilities and Stockholders' Equity	$2,766,722,000	$2,476,523,000

*Restated

(See Accompanying Notes)

Consolidated Statement of Changes in Capital Stock

(Dollars in Thousands)	Preferred Stock Number of Shares	Preferred Stock Stated Value	Common Stock Number of Shares	Common Stock Par Value	Capital in Excess of Par or Stated Value	Common Stock Held in Treasury Shares	Common Stock Held in Treasury Cost
At December 31, 1969							
Issued	18,491,013	$ 92,455	28,851,412	$28,851	$1,098,024	—	—
Held in Treasury	—	—	—	—	—	266,837	$14,111
Change in Stated Value	—	868,914	—	—	(868,914)	—	—
Purchased and Retired	(673,130)	(35,003)	—	—	11,078	—	—
5% Stock Dividend	—	—	1,477,418	1,477	62,052	17,128	—
Issued for Pension Fund	—	—	500,000	500	21,576	—	—
Poolings of Interests Transactions							
Treasury Stock Retired	—	—	(38,016)	(38)	(380)	(38,016)	(2,333)
Common Stock Issued	—	—	585,940	586	5,106	—	—
Purchases	—	—	—	—	—	208,034	9,439
*Other	(1,932)	63	19,468	20	194	(31,052)	(1,905)
At December 31, 1970							
Issued	17,815,951	$926,429	31,396,222	$31,396	$ 328,736	—	—
Held in Treasury	—	—	—	—	—	422,931	$19,312

*Principally conversion of preferred to common, issuance of stock under option, incentive and executive compensation plans and common stock used in acquisitions.

(See Accompanying Notes)

Notes to Financial Statements

Principles of Consolidation

The consolidated financial statements include the accounts of all subsidiaries owned more than 50 per cent, except three subsidiaries engaged in leasing activities, and a subsidiary organized during 1970 to finance certain receivables. These subsidiaries are not included in the consolidated financial statements because of the nature of their businesses. The finance subsidiary commenced business with the exchange of $26,682,000 of long term notes receivable for all its issued common stock. In the aggregate, the financing and leasing activities of these subsidiaries have not been significant.

The parent company's equity in the net assets of the consolidated subsidiaries exceeded the cost of those investments by $133,427,000 at December 31, 1970, which amount is included in consolidated earnings employed in the business. Approximately $457,961,000 of consolidated net assets at December 31, 1970 pertain to operations outside the United States, principally in Canada ($289,618,000), Venezuela ($36,057,000), Liberia ($16,585,000) and in Puerto Rico ($93,228,000).

The financial statements include Sun's equity in the undistributed earnings of the affiliated companies in which it owns a proprietary half interest. The increase in such equity amounted to $220,000 in 1970 and $739,000 in 1969.

Appropriate rates of exchange have been used to convert foreign currency statements to U. S. dollars. The conversion gains or losses, which are not significant, are included in consolidated income.

During 1970, Sun acquired five companies for 585,940 shares of common stock. For accounting purposes, these acquisitions have been treated as "poolings of interests," and results of operations for these companies are included in the consolidated statement of income for 1970. Since the results of operations of these companies are not material in 1970 and any prior year, the consolidated financial statements for prior years have not been restated. Earnings employed in the business at January 1, 1970 have been increased by $8,227,000 representing the retained earnings of the pooled companies at that date after reduction of $1,915,000 for treasury stock retired in connection with the poolings.

During 1970, the Company acquired 22.5 million shares of newly issued common stock of Great Canadian Oil Sands Limited for $95,656,000 which changed its percentage ownership in this subsidiary from 81.7% to 96.1%.

Consolidated Statement of Source and Application of Funds For the Years Ended December 31	1970	1969**
Funds Were Derived from		
Operations:		
Net Income	$139,075,000	$153,551,000
Charges to Income not involving Working Capital		
*Recovery of Capital		
(Depreciation, Cost Depletion, Amortization and Retirements)	127,831,000	117,486,000
Deferred Income Taxes	29,388,000	51,811,000
Other	1,370,000	1,350,000
Funds Derived from Operations	297,664,000	324,198,000
Net Reduction of Long Term Receivables and Investments	4,670,000	18,922,000
Contribution of Common Stock to Pension Fund	22,076,000	10,795,000
Borrowings	200,000,000	33,063,000
Disposition of Properties, Plants and Equipment	12,031,000	24,276,000
Other Sources	7,461,000	—
Reduction in Working Capital	9,559,000	—
Total Funds Available	$553,461,000	$411,254,000
Funds Were Used for		
*Capital Expenditures	$328,835,000	$255,131,000
Cash Dividend Payments	69,916,000	68,528,000
Prepayment of Pension Costs	23,804,000	12,691,000
Purchase of Company's own Stock	33,365,000	4,083,000
Reduction of Prior Borrowings	90,816,000	38,787,000
Net Liquidation of Prior Sales of Properties and Oil Production	6,725,000	21,977,000
Other Uses	—	969,000
Addition to Working Capital	—	9,088,000
Total Funds Used	$553,461,000	$411,254,000
*Not Including Intangible Development Costs of	$ 39,247,000	$ 47,304,000

**Restated

(See Accompanying Notes)

Inventories

Crude oil inventories are valued generally on a last-in, first-out pricing method based upon the market prices of crude oil prevailing in the field at the time of production or purchase, plus the cost of transportation to the refineries.

Refined products inventories are valued generally on a last-in, first-out pricing method based upon the value of the oils taken out of inventory for refining (as computed above), plus refining costs. Transportation costs from refineries to marketing centers are carried at average costs.

At December 31, 1970, approximately 23 percent of the value of crude oil and refined products inventories is valued at first-in, first-out or average cost.

Crude oil and refined products inventories, as valued on the foregoing bases, are stated at less than market.

Materials and supplies are valued at cost or less, principally on the basis of average cost. Work in process inventories are valued at cost less progress billings.

Depreciation, Cost Depletion, Amortization and Retirements

Depreciation policy for accounting purposes is designed to recover on a straight-line basis the cost of properties, plants and equipment during their estimated useful lives. Experience is reviewed from time to time and rates are revised when necessary.

The cost of developed or producing leaseholds, which excludes intangible development costs, is depleted on the basis of crude oil and natural gas produced from the properties leased. For income tax purposes, a mineral depletion allowance is deducted when in excess of depletion based upon cost.

During 1970, the Company changed its method of accounting for non-producing leaseholds. Previously the cost of such leaseholds was charged to income in the year they were abandoned. In 1970 the Company adopted the policy on a retroactive basis of amortizing the cost of such leaseholds over their projected holding periods based upon past experience. The effect of this change on the results of operations for 1970 and for 1969, which has been restated, is summarized below. Earnings employed in the business as of January 1, 1969 have been reduced by $31,217,000 for the cumulative effect of this change for years prior to 1969.

	1970	1969
	(Thousands of Dollars)	
Decrease in depreciation, cost depletion, amortization and retirements	$1,187	$2,735
Less related deferred income taxes	668	1,444
Increase in net income	**$ 519**	**$1,291**
Increase in net income per common share:		
After provision for cash dividends on preferred stock	$ .02	$ .04
Assuming full conversion of all preferred shares	$ .01	$ .03

Intangible Development Costs

The cost of drilling wells to develop new sources of crude oil and natural gas is charged to income as incurred. Included in intangible development costs is dry hole expense in the amount of $10,418,000 in 1970, and $19,057,000 in 1969.

Taxes

Direct taxes, excise taxes collected from customers and payroll taxes withheld from employees are shown in the following table:

	1970	1969
	(Thousands of Dollars)	
Charged to Income		
Capital Stock and Franchise	$ 2,924	$ 2,286
Payroll	10,633	9,978
Crude Oil and Natural Gas Production	51,952	50,744
Ad Valorem	29,330	27,511
Import, Excise, Sales and Other	6,764	8,169
	101,603	98,688
Income Taxes		
Federal	56,957	49,651
Foreign and Other	27,054	25,585
	84,011	75,236
	185,614	173,924
Collected and Paid for Others		
Excise taxes collected from customers	433,636	409,592
Taxes collected from employees	56,088	55,403
	489,724	464,995
Total	**$675,338**	**$638,919**

Taxes collected from customers and employees are not included in the consolidated statement of income.

Investment tax credits of $3,329,000 in 1970 and $4,790,000 in 1969 have been applied as a reduction of Federal income tax expense.

The provision for income taxes includes deferred amounts of $29,388,000 in 1970 and $51,811,000 in 1969, arising principally from additional deductions for past service pension costs and accelerated depreciation allowable currently for tax purposes.

Long Term Debt

The current portion of long term debt, amounting to $25,923,000 at December 31, 1970, and $21,685,000 at December 31, 1969, is included in notes and bonds payable. Long term debt due after one year at December 31 includes the following:

	1970	1969
	(Thousands of Dollars)	
Sinking Fund Debentures		
8½% payable $5,250,000 annually 1977-1999, $29,250,000 in 2000	$150,000	$ —
4⅝% payable $4,000,000 annually 1972-1989, $20,000,000 in 1990	92,000	96,000
4¼% payable $1,875,000 semi-annually 1972-1986, $15,000,000 in 1987	71,250	75,000
Convertible Debentures		
6% due May 15, 1975, partially convertible into common stock of a subsidiary company	8,363	9,579
Notes and Mortgages Payable		
7¾% due November 15, 1976	50,000	—
4½% payable $3,571,000 quarterly through 1974	42,857	57,143
5¾% payable $2,000,000 annually 1972-1990, $10,000,000 in 1991	48,000	50,000
8½%-9½% short term notes to be refinanced	—	58,136
6⅝% due January 1, 1972	10,000	10,000
4.95% payable quarterly through 1978	4,182	4,670
6¼%-9½% payable over varying periods up to 25 years	6,207	6,117
7⅜% payable 1975-1989	18,000	18,000
Other	11,257	18,287
	$512,116	**$402,932**

Stockholders' Equity

Each share of $2.25 cumulative convertible preferred stock is entitled to one-quarter vote and each share of common stock is entitled to one full vote, voting together as one class.

Each share of preferred stock is convertible into .766 of a share of common stock, subject to adjustment for stock dividends and certain other transactions and is redeemable at Sun's option on and after June 1, 1975, starting at $60 per share and declining $1 each year thereafter to $57 per share. The holders of the preferred stock have a preferential right in involuntary liquidation to receive $52 per share, or $55 per share if the liquidation is voluntary.

On June 23, 1970, the Board of Directors authorized an increase in the stated value of the preferred stock from $5 per share to $52 per share.

At December 31, 1970, 27,318 shares of unissued preferred stock are reserved for the exercise of outstanding stock options and settlement of incentive pay awards, and 13,667,944 shares of unissued common stock are reserved for potential conversion of issued and reserved shares of preferred stock.

Stock Option Plans

Under Sunray's incentive stock option plans in effect at the date of the merger, certain officers and key employees held options at December 31, 1970 to purchase 24,450 shares of preferred stock at prices ranging from $23.88 to $33.75. The options expire at varying dates through 1972 and no additional options may be granted under the former Sunray plans. During 1970 options for 14,633 shares were exercised at an average price of $29.69 per share and options for 1,650 shares expired.

Pension Plans

Sun and certain of its subsidiaries have contributory funded pension plans providing retirement benefits for their employees. The total expense for these plans was $27,441,000 in 1970 and $25,857,000 in 1969, which includes amortization of past service costs principally over 30 years. The Company's policy has been to fund the total pension expense plus additional amounts as may be deductible for income tax purposes. Using the most recent actuarial calculations available, the liability for vested benefits exceeds the total of the pension funds by approximately $63,800,000. Pension funds include $80,152,000 of prepaid pension costs.

Contingent Liabilities and Commitments

Sun is contingently liable for guarantees of loans payable by associated companies and others approximating $17,800,000 at December 31, 1970. Management considers that losses, if any, from these guarantees would not be significant.

Sun has long term leases for service stations, office space and other property and equipment. Under contracts existing as of December 31, 1970, and expiring at various dates after 1973, minimum annual rentals, without reduction for related rental income, will approximate $19,000,000 through 1973 and diminishing amounts thereafter.

Accountants' Report

LYBRAND, ROSS BROS. & MONTGOMERY
CERTIFIED PUBLIC ACCOUNTANTS

Board of Directors
Sun Oil Company
Philadelphia

We have examined the consolidated financial statements of Sun Oil Company and its consolidated subsidiaries for the year ended December 31, 1970. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances. We also made a similar examination of the financial statements for the year 1969 which have been restated to reflect the change in accounting for non-producing leaseholds, as described in the depreciation, cost depletion, amortization and retirements note to the financial statements.

In our opinion, the accompanying consolidated statements of financial position, income and earnings employed in the business, changes in capital stock and source and application of funds present fairly the financial position of Sun Oil Company and its consolidated subsidiaries at December 31, 1970 and 1969 and the results of their operations and the source and application of funds for the years then ended, in conformity with generally accepted accounting principles applied on a consistent basis.

Lybrand, Ross Bros. & Montgomery

Philadelphia, Pa.
February 16, 1971

Five Year Financial Summary

	1970	1969	1968	1967	1966
Revenues (Thousands of $)					
Sales and Other Operating Income	1,941,906	1,837,757	1,778,183	1,710,573	1,562,603
Other Income	20,060	21,082	23,028	30,312	28,909
Total—excluding excise taxes	1,961,966	1,858,839	1,801,211	1,740,885	1,591,512
Net Income (Thousands of $)	139,075	153,551	165,647	159,283	141,401*
Return on Revenues (%)	7.1	8.3	9.2	9.1	8.9*
Preferred Dividend Requirements	40,994	41,602	41,624	41,624	41,624
Net Income Applicable to Common Stock	98,081	111,949	124,023	117,659	99,777*
Earned Per Common Share					
After Preferred Cash Dividends ($)	3.19	3.74	4.17	3.98	3.39*
Assuming Conversion of Preferred ($)	3.11	3.48	3.77	3.64	3.24*
Cash Dividends Paid (Thousands of $)					
Sun Preferred—after merger	40,994	41,602	9,490	—	—
Sun Common	28,922	26,926	25,208	23,851	19,646
Sunray Common—before merger	—	—	20,778	26,288	26,051
Stock Dividends on Common Stock (%)	5	6	6	5	6
Shares Distributed (Thousands)	1,477	1,633	1,540	1,222	1,383
Stock Split (4 for 3)					
Shares Distributed (Thousands)	—	—	—	—	5,763
Stock—December 31 (Shares in Thousands)					
Sun Preferred—Shares Outstanding	17,816	18,491	18,500	—	—
—Number of Stockholders	90,241	88,176	89,844	—	—
Sunray Common (Prior to 1968)					
—Shares Outstanding	—	—	—	18,462	18,443
—Number of Stockholders	—	—	—	99,907	101,363
Sun Common—Shares Outstanding	30,973	28,585	26,777	25,118	23,797
—Number of Stockholders	40,154	37,975	35,746	34,537	33,228
Stockholders' Equity (Net Assets)					
December 31 (Thousands of $)	1,661,262	1,585,375	1,487,733	1,367,115	1,249,361
Return on Average Stockholders' Equity (%)	8.6	10.0	11.6	12.2	11.9*
Capital Expenditures (Thousands of $)					
Exploration and Production					
Leases	70,867	36,531	55,861	43,749	35,569
Equipment	25,452	40,673	41,496	51,665	35,036
	96,319	77,204	97,357	95,414	70,605
Natural Gas Plants and Other	22,574	19,044	21,426	15,772	10,190
	118,893	96,248	118,783	111,186	80,795
Manufacturing	86,454	40,271	41,829	81,957	62,629
Marketing	88,245	80,347	90,124	71,686	72,864
Transportation	17,900	24,888	10,165	11,428	3,649
Mining	9,660	9,443	3,944	31	165,780
Shipyard and Others	7,683	3,934	3,751	4,938	8,920
	328,835	255,131	268,596	281,226	394,637
Intangible Development Costs	39,247	47,304	54,898	52,700	58,451
Total	368,082	302,435	323,494	333,926	453,088
U.S. and Canada (%)	97	93	91	92	96
Other (%)	3	7	9	8	4
Expenditures for Exploration and Development (Thousands of $)					
Capital Expenditures	96,319	77,204	97,357	95,414	70,605
Intangible Development Costs	39,247	47,304	54,898	52,700	58,451
Other Expenses including Lease Rentals	41,829	49,466	50,249	55,124	55,360
Total	177,395	173,974	202,504	203,238	184,416
U.S. and Canada (%)	86	89	88	86	87
Other (%)	14	11	12	14	13
Taxes (Thousands of $)					
Operating	101,603	98,688	91,587	81,763	78,366
Domestic and Foreign Income	84,011	75,236	69,060**	59,070	54,406**
Paid or Accrued by Company	185,614	173,924	160,647	140,833	132,772
Collected from Customers	433,636	409,592	384,944	352,127	335,513
Collected from Employees	56,088	55,403	48,638	43,284	37,110
	675,338	638,919	594,229	536,244	505,395
Wages and Benefits (Thousands of $)					
Oil Division—U.S. and Canada	302,233	282,589	263,833	249,833	224,543
—Other	9,375	8,372	6,317	5,318	5,000
	311,608	290,961	270,150	255,151	229,543
Shipbuilding and Repair	44,135	42,570	45,139	41,999	40,669
	355,743	333,531	315,289	297,150	270,212

*Excludes extraordinary income of $17,280,000.
**Includes taxes of $5,700,000 in 1968 and $9,687,000 in 1966 on sales of Avisun and Great Lakes Pipe Line respectively.
Net income for 1966-1969 and calculations based on net income have been restated to reflect changes in accounting methods (see financial notes).
The years 1966-1969 have not been restated for acquisitions in 1970 recorded on a pooling of interests basis.

Five Year Operating Summary

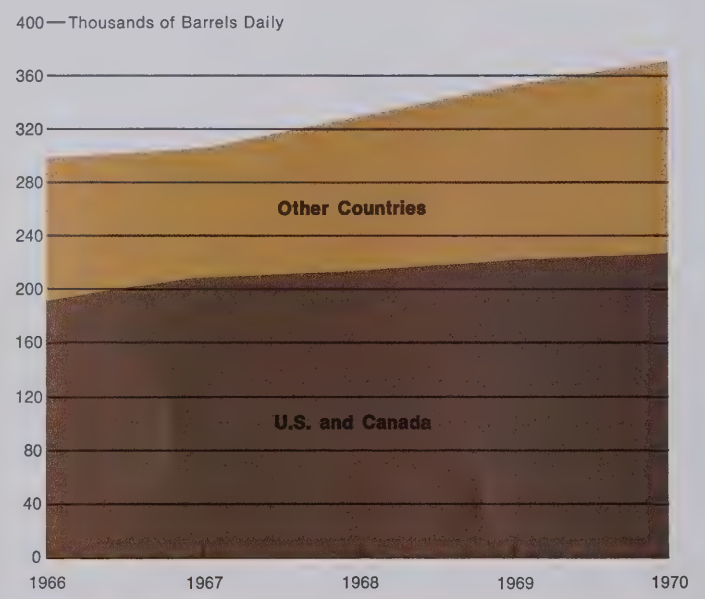
	1970	1969	1968	1967	1966
Average Number of Employees					
Oil Division—U.S. and Canada	23,247	23,719	23,983	23,580	22,144
—Other	949	901	806	539	547
	24,196	24,620	24,789	24,119	22,691
Shipbuilding and Repair	4,169	4,225	4,657	4,731	4,698
	28,365	28,845	29,446	28,850	27,389
Stock Purchase Plan					
Number of Employees Participating in Liquidation at 6/30	7,930	7,973	8,034	8,075	8,182
Shares of Sun Common Stock Distributed (Thousands)	253	253	297	337	310
Savings Plan					
Number of Employees Participating at 12/31	1,411	4,232	3,937	3,965	3,865
Net Production of Crude Oil and Condensate (Barrels daily)					
U.S. and Canada	229,248	219,626	215,690	211,280	193,756
Other	134,049	133,519	113,380	101,991	108,130
	363,297	353,145	329,070	313,271	301,886
Natural Gas Sales (Million Cubic Feet daily)	1,441	1,571	1,424	1,290	1,265
Processed Natural Gas Liquids (Barrels daily)	45,836	47,883	47,646	41,458	37,450
Net Wells Completed					
Oil	213	206	224	273	317
Gas	24	36	67	89	86
Dry	58	139	143	153	223
	295	381	434	515	626
Net Producing Wells					
Oil	8,996	9,135	9,424	9,376	9,291
Gas	1,283	1,468	1,481	1,415	1,392
	10,279	10,603	10,905	10,791	10,683
Acreage (Thousands)—Producing	1,821	1,359	1,052	991	977
—Undeveloped	42,080	40,949	45,443	48,153	48,588
Synthetic Crude—net produced for shipment (Barrels daily)	32,740	27,336	23,685*	—	—
Crude Refined (Barrels daily)					
Corpus Christi, Texas	42,146	43,202	41,139	41,682	40,491
Duncan, Oklahoma	45,233	45,435	45,842	44,490	44,249
Marcus Hook, Pennsylvania	147,728	154,552	157,871	147,049	144,953
Sarnia, Ontario	31,588	30,842	31,412	26,446	29,309
Toledo, Ohio	103,423	104,512	104,263	94,577	100,952
Tulsa, Oklahoma	85,524	82,975	81,032	80,215	80,204
Monrovia, Liberia	7,714	5,124	246**	—	—
	463,356	466,642	461,805	434,459	440,158
As % of Rated Capacity	93	94	96	93	95
For Sun's Account—Venezuela	22,050	22,241	22,039	20,628	18,177
Shipments through Sun Owned or Operated Pipelines (Millions of Barrel Miles)					
U.S. and Canada					
Crude Oil	7,026	7,066	6,891	6,948	6,980
Refined Products	17,341	17,369	17,182	16,554	16,024
	24,367	24,435	24,073	23,502	23,004
Other—Crude Oil	3,170	3,326	3,167	2,762	2,838
Ocean Tankers Owned	7	7	9	9	9
Capacity (Barrels)	2,319,900	2,220,400	2,000,600	2,000,600	2,000,600
Deadweight Tonnage	314,449	308,346	278,925	278,925	278,925
Sales of Refined Products (Barrels daily)					
Gasoline	304,420	301,854	285,446	277,276	271,121
Middle Distillates	132,832	128,995	129,562	133,343	131,736
Residual Fuel	31,016	29,465	28,543	25,885	24,944
Chemicals	16,781	19,565	19,587	17,796	17,262
Lubricants and Other	68,215	71,069	60,826	60,712	58,066
Total	553,264	550,948	523,964	515,012	503,129
U.S. and Canada (%)	96	97	96	94	94
Other (%)	4	3	4	6	6
Service Station Type Outlets Retailing Branded Motor Products	17,200	16,900	17,100	16,800	17,000

*92 days—plant became commercially operational October 1, 1968.

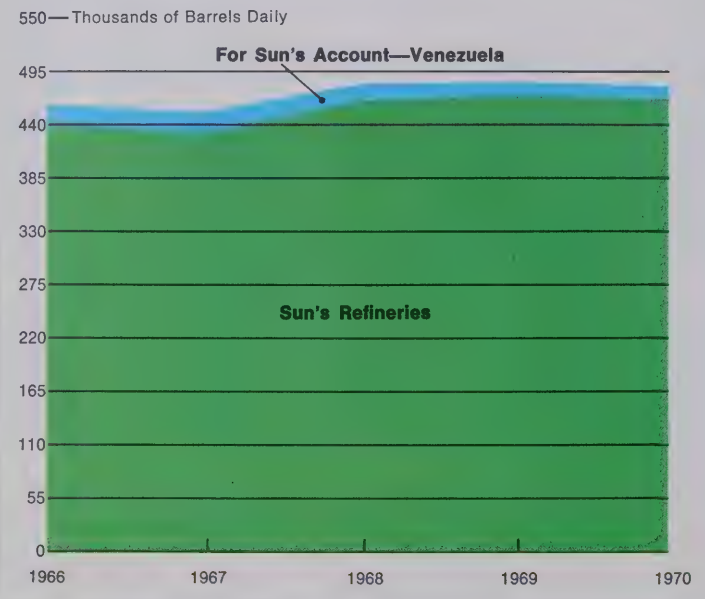
**Based on full year—new refinery on stream late in 1968.

The years 1966-1969 have not been restated for acquisitions in 1970 recorded on a pooling of interests basis.

Net Production of Crude Oil and Condensate



Crude Refined



Net Production of Crude Oil and Condensate–1970 *(Barrels daily)*

United States	
Arkansas	2,770
California	6,770
Florida	3,332
Kansas	4,071
Louisiana	33,042
Michigan	3,356
Mississippi	6,554
Montana	998
New Mexico	6,265
Oklahoma	24,101
Texas	115,348
Utah	2,168
Wyoming	2,666
Other States	3,465
	214,906
Canada	14,342
	229,248
Dubai	3,987
Iran	17,823
Venezuela	112,239
	363,297

Reserves of Liquids and Gas

At December 31, 1970, net proved underground reserves of crude and condensate in the United States and Canada were estimated to be 1,018,000,000 barrels; in Iran, 127,000,000 barrels, and in Dubai, 55,000,000 barrels. Venezuela crude reserves were estimated at 239,000,000 barrels. Estimated net reserves of recoverable natural gas liquids were 197,000,000 barrels, mostly in the United States and Canada. Net reserves of natural gas were estimated at 7.6 trillion cubic feet including 400 billion cubic feet in the British North Sea.

Natural Gas Sales–1970 *(Million Cubic Feet daily)*

United States	
Arkansas	7
California	7
Colorado	10
Kansas	8
Louisiana	442
Michigan	5
Mississippi	15
New Mexico	34
Oklahoma	123
Texas	730
Other States	1
	1,382
Canada	38
	1,420
North Sea	21
	1,441

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Annual Meeting:
Tuesday, April 20, 1971, 2:00 p.m., Sun Center,
Feltonville, Delaware County, Pennsylvania

SUN OIL COMPANY
1608 WALNUT STREET
PHILADELPHIA, PA. 19103

The next generation:
their future is our future.

not drink alcoholic beverages. His only personal indulgences were the orchids he grew, the cigars he liked to smoke—and golf. "Golf keeps me alive," he once remarked to a visitor.

Mr. Pew was also known for his remarkable memory. He memorized his speeches, word for word, so that he could talk directly to his audience without the interruption of looking at notes. Jno. G. (Jack) Pew, a Sun director, recently recalled, "Howard once told me that some months earlier he had made six speeches in six nights on six different subjects, all of which he memorized from beginning to end. He said that today he could repeat those speeches word for word if he had to. Frankly, I think that's awfully good for anybody, let alone someone who is 89."

When gasoline was rationed during World War II, Mr. Pew was scrupulous about staying under his alloted quota. "He frequently rode a bicycle or walked," says Mrs. Frances Pew Hayes, one of his daughters, "so Mother could use the car anytime she wanted to."

A man of strong convictions and direct action, Mr. Pew often found himself at the center of controversy, despite his disdain for the spotlight. He was a student of history, and his sense of the destiny of man made him a staunch believer in the ideals upon which the United States was founded.

Mr. Pew was also a deeply religious man. As a member of the United Presbyterian Church, he favored historic, orthodox Christianity and believed the church's main role was to provide spiritual guidance.

He met Billy Graham, the noted evangelist, about 18 years ago, and the two developed a binding friendship. "Mr. Pew is probably the best-informed layman on the Bible and religious matters in the United States," Mr. Graham once commented.

At Sun, Mr. Pew's integrity and compassion for people were almost legendary. After a fire at Sun's Marcus Hook, Pa., refinery in 1946 hospitalized several employees, Mr. Pew made it a point to stop and see the men each morning for five or six weeks. "He'd bring books and things like that," recalls Clarence Thayer, one of those injured in the fire and now a retired vice-president. "When he learned some men would need skin grafts, he got the top man to do the job."

Although Mr. Pew worked up until a few months before his death on November 27, 1971, he often said he retired when he stepped down as president. This was, in a way, a kind of private joke. For although he gave more of his time to numerous philanthropies and other interests, he continued to be alert to company plans and developments, and participated in major decisions. He remained a member of Sun's board of directors, to which he was first elected in 1906. He also met regularly with the board's executive committee. Then in 1963, upon the death of his younger brother, Joseph N. Pew Jr., he assumed the board chairmanship.

In stepping down as president in 1947 and as board chairman in 1970, Mr. Pew was succeeded in each instance by Robert G. Dunlop, the man with whom he shared his deepest confidences and upon whom he increasingly relied for the complex policy decisions that shaped Sun's destiny. Following the company's merger with Sunray DX Oil Company, Mr. Pew became chairman of the executive committee.

Mr. Pew's knowledge of the oil industry was grounded in practical experience. One of his first assignments was as an engineer at the Marcus Hook refinery, and one of his earliest contributions to Sun's success was the development of a process for producing quality lubricants from naphthenic crude oil. Out of that undertaking came an absorbing interest in technology that led Sun to become a pioneer in the development of many refining processes.

Mr. Pew was fond of reciting poetry. One of his favorites was "The Bridge Builder." Part of it reads, "There follows after me today a youth whose feet will pass this way . . . Good friend, I am building this bridge for him."

Countless times, J. Howard Pew cited those lines referring to others; most of them would agree it is his own most fitting epitaph.

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CONTENTS

New Explorers in the Far North 2

Easy Glider of the Arctic 8

The Price the Future Demands 10

Giving the Whale a Fighting Chance 14

Prescription for a Healthy Factory 18

Slicing History from the Ocean Floor 21

A Girl is a Diamond's Best Friend 26

WHICH WAY IS NORTH? When you're already north of the magnetic north pole, a regular compass isn't much help in telling directions. That's why Sun's explorers in the Canadian Arctic had to set up transponder towers like the one shown on our cover. The signals emitted by these radio transmitters were picked up by radar units mounted on vehicles and were used for navigation.

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NEW EXPLORERS IN THE FAR NORTH

Long a challenge to bold men, the Canadian Arctic is now the site of intensive oil exploration.

A big cargo-carrying Lockheed Hercules lands at Resolute—crossroads of the Canadian Arctic Islands.

American, Canadian and Northwest Territories' flags at Resolute Airport symbolize the cooperative aspect of oil exploration in the Far North.

Tower at this advance drilling camp on Melville Island is topped by a radio homing beacon used for navigation.

THE TIME IS EARLY APRIL, BUT IN THE Canadian Arctic the thermometer reads 46 degrees below zero. A Twin Otter flies over desolate Cornwall Island and touches down at a tiny campsite on a frozen sea 30 miles west of the island. The passengers debark.

Geologist Edward W. Heath recalls his arrival at Sun Oil Company's Arctic research camp located on 10 feet of ice north of the Arctic Circle:

"It was so desolate, so monotonous and hostile, that I felt I was stepping out onto the surface of the moon."

What Vernon F. Wetzel, a senior research engineer for Sun, remembers most was the cold:

"The wind and cold made our eyes water and froze our eyelashes shut. We had to pull the ice off before we could see again. Our breath quickly frosted the lenses of our optical instruments, making sightings difficult. We were careful to breathe only the warm air behind our wool face masks or furry fringe of our parka hoods, which extended beyond our faces. Direct inhalation of the minus-40-degree air would soon have frozen our lungs, resulting in permanent damage or even death."

For two months last spring, through blasting wind and snow, these two men and others bucked the elements to set up radar guidance systems, collect geological and geophysical information, and conduct extensive research on the total Arctic environment.

Why did they go to all this trouble? Fred E. Buchanan, manager of Sun's Canadian Exploration Region explains:

"The Canadian Arctic is one of the large untested sedimentary areas in the world. Its potential hydrocarbon-bearing structures are extremely large and its sedimentary sections very thick. This is one of the places in North America where we are testing for giant reserves."

Kingsley V. Schroeder, Sun vice president and head of North American exploration, adds another reason:

"You must keep in mind that current oil imports from the Middle East can be cut off at a moment's notice. If this happens, we are in big trouble unless we have developed large, new reserves."

Sun first acquired drilling rights in the Canadian Arctic in 1968 by filing for permits from the Canadian government and through an agreement with Los Angeles-based Global Marine, Inc. By 1970 Sun had part interest in 6.5 million acres north of the Arctic Circle. Today, Sun has interests ranging from 13.5 to 100 percent in 36 million acres, both onshore and offshore, making it the second largest permit-holder in the Canadian Arctic.

Five wells have been or are being drilled by Sun, but they were as much stratigraphic tests as they were wildcat wells. Indeed, the thrust of the company's effort has been to learn as much as possible about the subsurface geological formations and to determine the best locations for future wildcat drilling.

A bleak and forbidding land, the Canadian Arctic consists of some 20 major islands plus many small islands and all of Canada's continental fringe north of the Arctic Circle. Here in this area of snow and ice, of glacier-edged peaks and monotonous tundra where the ground is permanently frozen to a maximum depth of 2,300 feet, live only a few thousand people — mostly North America's Eskimos.

To date, 29 wells, including Sun's five, have been or are being drilled in this area by more than a half a dozen operators. Several have encountered natural gas. Nearly all have found encouraging sedimentary rock.

A challenge to adventurous men from the time of early Vikings, the Arctic has lured explorers from Sir Martin Frobisher and Henry Hudson in the 16th and 17th centuries to Sir John Franklin and Admiral Robert E. Peary in more recent times.

Today, the challenge is still there, and meeting it is more important than ever, for

continued

Dog sleds are a thing of the past, thanks to modern tracked vehicles such as this Nodwell transporter.

The Canadian Arctic includes the northern fringe of the North American continent, plus the islands which taper north towards the top of the world. Sverdrup Basin, outlined in red, is the geological area of most interest to Sun.

Thrust of Sun's effort has been to gather subsurface geological data for future wildcat drilling. Ice-covered Arctic Islands area is the focus of oil exploration.

the Arctic's new explorers have come to tap the oil and gas so urgently needed to supply the world's energy demands.

The Sun exploration team sent to the Arctic last spring was given the assignment of gathering information on the Sverdrup Basin, a 200,000-square-mile geological formation that underlies both land and sea in the Canadian Arctic Islands area (see map). Their camp, out on the ice 30 miles west of Cornwall Island, served as a base of operations for exploration activities. Later, the camp was moved farther north to Kristoffer Bay, just off the coast of Ellef Ringnes Island.

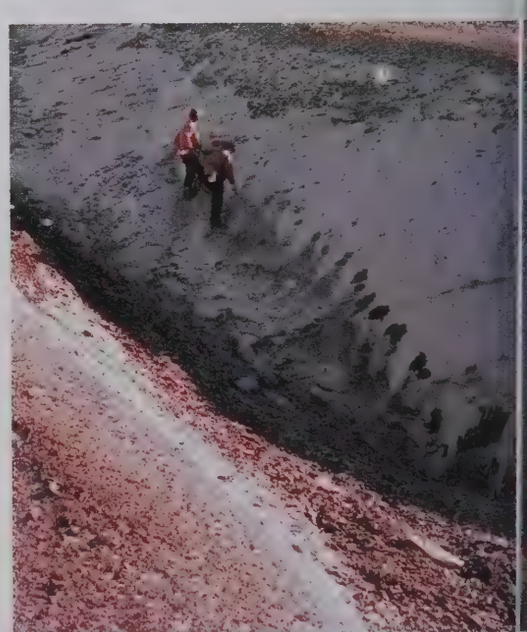
The group had three goals: to take core samples of the ocean bottom, to acquire well-defined subsurface information through seismic reflection and to collect environmental data including the thickness, strength and movement of the ice—vital knowledge in designing an Arctic drilling system.

In the mainland United States, techniques for geological and geophysical surveys are routine. But in the Arctic, little if anything is routine.

The men worked 12-hour shifts and spent 16 to 18 hours a day just getting equipment ready for operation. But the long hours paid off. Geologist Heath describes one of Sun's accomplishments:

"Our job was to take samples of the ocean bottom and to learn as

Men from Parker Drilling Company, a Sun subcontractor, struggle with a drilling rig on Bathurst Island. Two Sun wells were drilled on Bathurst, but both were later abandoned.



Lack of covering vegetation in the Arctic exposes an outcrop of underlying rock formation for study by two Sun geologists.

much as we could about everything in the ocean. To do that, we drilled a hole through the ice and dropped a core barrel through the hole, penetrating the ocean floor about six feet. Then we pulled our core samples from the bottom and conducted various mineralogy, paleontology and geochemical studies on them.

"Collecting ocean-bottom cores under the ice was a success for Sun. We do not know of anyone else doing this kind of work routinely."

Kenneth H. Carter, a Sun geophysical research scientist, talks about another Sun accomplishment:

"To get a good seismic reflection picture of the strata below the ocean bottom, we had to take our readings from out on the ice. However, attempts to gather geophysical information this way had been largely unsuccessful in the past because of unwanted seismic noises.

"When we set off a seismic explosion—usually a charge of dynamite—in the water or buried in the ocean floor, the ice and water layers would trap the reflections — or energy waves — bounce them around and scatter them. As a result, our receiving equipment would pick up distortions — or noises — which obscured our geophysical readings.

"We started research in this area in 1968, cooperating with our Canadian Region geophysicists. It has taken since then to develop a seismic system to filter out most of the unwanted noises. This knowledge will aid Sun in future seismic reflection efforts in Arctic ice-covered areas."

While performing these operations and other day-to-day tasks, Sun's Arctic team encountered personal discomfort and sometimes danger. Senior Research Engineer Wetzel recalls:

"We had to take our mittens off whenever we tied a rope. In a few seconds, our hands would stiffen from the cold, which at 30 degrees below zero, with a 25 mile-per-hour wind, equaled a chill factor of 89 below. Then we would have to put our mittens back on until our joints felt flexible again. This routine stretched a one-minute job to four or five minutes. At night, when temperatures dipped to 40 below and the windchill factor would drop to minus 104 degrees, the same one-minute job took eight minutes to do."

Fortunately, there were no serious accidents, although one employee of Ray Geophysical, a Sun subcontractor, had a harrowing experience with a polar bear.

According to witnesses, when the bear lumbered into camp one day, everyone headed for cover but this man, who stopped to take a picture. He had his head down, focusing his camera on the bear, when it charged and knocked him to the ground. The bear tore the man's parka but didn't paw or bite him, just sniffed all around and looked him in the eye. The man said the bear's nostrils looked like the barrels of a 12-gauge shotgun.

Another man saw his companion's plight and jumped aboard a bulldozer whose engine had been left running. Maneuvering it toward the bear, he scared the animal away.

Aside from the hostile conditions and ice problems, operations were also made difficult by the remoteness of the area. James E. Thompson, a Sun manager of geophysics, discusses supply difficulties:

"With a population of about 400, Resolute is the largest community in the islands, but it's not what you'd call a bustling seaport. Because the port is icebound except for a few weeks each summer, usually only one cargo ship a year goes there. So you have to figure out what supplies you'll need far in advance. The fuel we used last spring, for example, was shipped to Resolute in the summer of

continued

Polar bears generally try to stay as far away from man as possible. However, one member of the Sun exploration team was mauled while taking a picture of a bear that wandered near camp.

Sighting of a single caribou is unusual. The animals usually travel in herds, and the population is on the increase.

Changing Far North scene includes traditional Eskimo Husky and seismic exploration vessel in background.

Biting wind and cold hampered operations. Chill factor sometimes dropped to minus 104 degrees, turning a one-minute job into an eight-minute ordeal.

Latest in Arctic attire, priced at $500, is modeled on location by Sun research engineer Vernon F. Wetzel.

Ice pressure ridges, created by ice movement, present a major obstacle to surface transportation in the Arctic.

1970. This saved us $1.50 a gallon in transportation costs compared to flying it up."

Everything done in the Arctic requires high transportation costs. And although the once-a-year ship to Resolute is used when possible, the real workhorse of the Far North is the airplane. Every Wednesday night, a turboprop Lockheed Electra, under charter to Sun, carries men and cargo some 1,500 miles from Edmonton, Canada, to Resolute. The Twin Otter, also under charter to Sun, is based in Resolute. This smaller, 10-passenger, twin-engine plane is used for inter-island trips for small groups.

To move anything as large as a drilling rig, however, requires a big Hercules air cargo carrier. It may take the plane some 80 trips to move the rig, but air transport is the only sure way to get it there.

As Sun gains experience in the Arctic, the costs of operations decline. A. D. Brown, Arctic project manager, notes:

"To move a rig to the Arctic last year cost $600,000 for the first move, $350,000 for the second move and $250,000 for the third move. It takes two weeks to rig down, two more weeks to move, and two weeks to rig up again."

All told, there were about 50 people at the camp off Cornwall Island (and later at Kristoffer Bay), including men from companies doing contract work for Sun. For some, it was their first experience in the Arctic; others were Arctic veterans. But novice or old pro, everyone saw or learned something new.

Research Engineer Wetzel, for example, found out just how permanently frozen the permafrost really is:

"When several of us first tried to

This island-hopping, 10-passenger, turboprop Twin Otter aircraft is best noted for its reliability—an important quality in this desolate land.

Articulated, or jointed, vehicle was used for trips away from base camp. Ice boring equipment is mounted on rear half of the exploration vehicle.

set anchor lines for a 40-foot transponder tower, we used a portable electric earth auger with a special permafrost bit to drill the holes."

(A transponder is a radio signal transmitter and responder used in navigation.)

"None of us was heavy enough to keep the bit cutting. The drill never penetrated the earth; it just nicked the surface and spun the operator around. At 35 degrees below, the permafrost was like rock. Finally we had to drive in mountain climbers' pitons as anchors for guying the tower."

In the Arctic, distinguishing low-lying islands from the surrounding sea is difficult when everything is covered with ice and snow. One major way to tell: observing the ice ridges that pile up along the shore.

The tremendous roughness of the ice surprised everyone. There were great regions where even Sun's specially-built articulated vehicle couldn't get over the mounds of ice. As a result, mobility was only about 15 per cent of what was expected.

The articulated vehicle was used for trips away from camp. Developed by Applied Research Development Company, of Houston, it incorporates many features made especially for Sun. Its chassis is articulated—or jointed—and swivels in the middle, enabling it to travel over rough terrain. It can float and be easily broken down for airlifting by helicopter.

The camp itself consisted of large skid-mounted trailer-type units which were used as a kitchen and mess hall, dormitories, offices, bath and laundry, and a power plant. Various work areas were enclosed in tents. The trailer-type units were flown in from Edmonton to within 50 miles of the campsite location off Cornwall Island. From there, they were pulled across the ice by tractor to their destination.

Just knowing where you are in these ice-covered locations is no small feat. Compasses were useless to the group, since the camp was actually north of the magnetic north pole, which is now located near Bathurst Island.

The first of the group to arrive had the task of installing the transponders that would later be used by seismic and other exploration teams to determine their locations accurately. To do this, the advance party had to find triangulation stations established by the Canadian government for purposes of surveying. Mr. Wetzel describes the difficulty they had in doing this:

"A triangulation station is marked by an inch-and-a-half-square aluminum post with identification numbers stencilled on it. Because the post only sticks out of the ground about three inches, the government puts an angular tower above it. Often, however, the tower has blown over and is covered by drifted snow.

"We couldn't find the first one we looked for, so we flew in a helicopter to another location and spotted its tower. Using this tower for reference, we flew back and found some drums of gasoline left behind by a previous party for emergency use. On landing, we discovered the remains of a tower. The snow was a foot and a half deep, but after a careful search of the area, we finally located the small marker post."

Before the trip, everyone received survival training, reference manuals and special medical kits. Each man's set of cold weather gear, from thermal underwear to parkas, mittens, boots, face mask and special sun goggles, came to about $500.

The cold winter months are the busiest for exploration in the Arctic. Because the water is iced over and the ground is frozen solid, transportation over the surface is comparatively easy.

In summer the reverse is true. The thaw causes the ice between the islands to break up and leaves only a thin mat of tundra vegetation to insulate the frozen permafrost from the melting rays of the sun. If the tundra is scarred, as it would be by most vehicles traveling on it in the summer, the upper layers of the permafrost would soon turn into a slushy mixture of sand and water. Harold Illich, a Sun geologist, recalls the effects of the thaw:

"The weather moderated within a few days because of the 24-hour sun, and the temperature rose into the 40's. Before we knew it, we were ankle-deep in water at our campsite. We had to get off the ice fast if we didn't want to end up at the bottom of Kristoffer Bay."

What has Sun discovered through its exploration effort? Much of the information is confidential, of course, but the company is encouraged by its geological and geophysical findings in the Sverdrup Basin.

In order to have economic success in the Arctic, however, hydrocarbon reserves in the billions of barrels must be found — much larger than the amount needed for economic success in, say, Texas. Actually finding such reserves will depend in part, at least, on the skills and perseverance of Sun's new explorers in the Far North. ◆

Easy Glider of the Arctic

Can a 4,000-ton drilling barge cross the Arctic landscape without damaging the fragile tundra, then move offshore and drill for oil in icebound waters? The answer to that question may be crucial to Sun Oil Company's future exploration efforts north of the Arctic Circle.

The Far North is a key area for future oil exploration, according to Sun's geologists and geophysicists. As always, however, the only way to know for sure whether oil is there is to drill a well and see what you find. That's where the problem lies. Conventional drilling rigs work well in the Arctic as long as they are on land. Once you move offshore, however, difficulties begin to mount.

There is only a month or two out of the year when the ice melts enough to allow passage of a conventional offshore drilling barge. During the rest of the year, the waters are either in the process of freezing or thawing, or are actually frozen solid.

In some places where the water is iced over year around, you could take a small land rig out on the ice, but unfortunately the ice drifts about on the water, and would, of course, take the rig right with it, snapping off the drill stem.

Enter ACT-100, a 250-ton air-cushion transporter that can glide on a cushion of air across water, firm ice or any relatively level terrain. Mounted on the underside of the 57-by-75-foot vehicle is a large forced air system which lifts ACT-100 about four feet off the ground. The forced air is contained by a flexible nylon skirt which forms a partial seal with whatever surface the vehicle is crossing. If the air blowers are shut down over open water, the unit will settle into the water and float on its hull.

As large as this vehicle is, it is only a prototype for one many times its size. Only in the planning stage now, the larger vehicle—in the 2,000- to 4,000-ton range—would carry a self-contained drilling rig and would eventually enable Sun to drill seven or more months of the year in the Far North offshore area.

Despite ACT-100's smaller size, though, it is still much larger than any other air-cushion vehicle ever built. Its payload is 100 tons—about twice that of the British Hovercraft Corporation's air-cushion vehicle which currently ferries cars and passengers across the English Channel.

One key difference: ACT-100 is not self-propelled as other air-cushion vehicles have been. Instead, it is towed by a tracked vehicle on land or ice and by a boat in open water. This eliminates the control aspect and greatly simplifies the operation.

Sun Oil Company, along with the Canadian government, has helped fund the development of ACT-100, which was built by Arctic Engineers and Constructors, of Houston, and its affiliate company, Arctic Systems, Ltd., of Calgary. Sun has also taken an active part in testing the vehicle.

Performance tests were conducted last spring near Edmonton, Alberta, Canada. There, the vehicle successfully operated over level and gently rolling terrain, as well as over ditches, water and other obstacles.

In further testing, still under way, Sun hopes to gain more air-cushion-transporter information that can be applied to the proposed giant Arctic drilling system (ADS) vehicle. These tests, begun during November at Yellowknife on Great Slave Lake in northern Canada, are using ACT-100 to learn how the ADS will perform while being towed over various conditions of ice. Sun's Arctic project manager, A. D. Brown, is in charge of the testing, the results of which will not be evaluated until the tests are completed next spring.

Although ACT-100 is a useful transporter and is valuable in testing the air-cushion principle, it is not large enough for exploratory drilling. However, the much larger 2,000- to 4,000-ton ADS vehi-

KEEP OFF THE GRASS! That's exactly what this 250-ton air cushion transporter is doing as it glides across an open field in tests at Edmonton, Canada. Inset shows that the vehicle can also cross water (left). Key to the air cushion principle is the nylon air-containment skirt on which a man is standing.

cle, if and when it is built, will be designed primarily for drilling.

"A drilling rig will be mounted on top of it," says Fred E. Buchanan, Sun's Canadian exploration manager in Calgary, "and despite limited movement of the ice, the ADS vehicle will be able to keep itself positioned directly over the drill stem."

H. D. (Bart) Ferguson, manager of production research at Sun's laboratory in Richardson, Texas, explains how this will be done:

"Once the air-cushion ADS has reached the drilling location, the air blowers will be stopped and the skirts retracted, permitting the vehicle to float on its hull, just like a barge. Anchors connected to winches on the corners of the hull will then be put out in several directions on the ice.

"The winches will be computer controlled so that if the ice moves, the floating vehicle will maintain its position over the drilling spot. As its hull, which will be heated, is drawn up against the edge of the ice, the ice will melt and move past the vehicle. If the ice starts moving back, the winches will pull the vehicle the other way."

Since ACT-100 does not have this heating capability, direct tests will not be run on this aspect of the operation at Yellowknife. Off-site tests, however, will be run with another device to make sure that the theory holds up in practice.

Even if the larger ADS vehicle is built, there will still be a few months out of the year when offshore drilling will not be feasible, despite the vehicle's ice-melting equipment. Sidney C. Pitzer, manager of research at Sun's Richardson Laboratory, points out:

"Drilling operations will have to stop when the ice starts to break up in the spring and can't be resumed until the water is free of ice. Later, when ice starts to form again, the ADS will have to be taken back on land until the ice becomes solid. Theoretically, because it is such a versatile vehicle, the ADS could be used for drilling onshore during this time."

In fact, a major advantage of the air-cushion vehicle is its onshore mobility. It can glide over land with little disturbance to the fragile tundra that covers the permafrost since nothing comes in contact with the ground but the vehicle's flexible air-containment skirt.

The towing vehicle, or tractor, touches the ground, of course. But disturbance of the terrain is minimized since the tractor's weight is dispersed by a very wide tread.

"We'd like to move directly to final design of the ADS as soon as possible," says Mr. Pitzer, "but we will have to evaluate the Yellowknife tests before we can take that step." If the tests prove successful and the ADS vehicle is built, Sun will have exclusive rights to the first one. However, this huge easy glider of the Arctic will be just one part of the hardware needed to get oil from under offshore waters.

"We need a way to produce oil continuously in these ice-covered Arctic waters," says Production Research Manager Ferguson. "There is now no economical way to build platforms that are strong enough to withstand the crushing movement of the Arctic ice. As a result, Sun is working to develop a completely self-sufficient underwater production system. There are some subsea systems being built now, but they are still experimental and, in all cases, they have to relate to a platform or to the surface. This would be difficult, if not impossible, in most Arctic areas.

"What we are trying to develop at Sun is a total system in which we can drill the well from the surface, complete it on the sea floor, produce it on the sea floor, and transport the crude oil to shore through underwater lines."

Such underwater companions would no doubt make the Arctic's easy glider a little happier. After all, it's kind of lonely floating around in ice water all by yourself. ◆

THE PRICE THE FUTURE DEMANDS

Meeting future U.S. energy needs without becoming dangerously dependent on imported oil will demand a price of us all. But this price must be paid if the U.S. is to preserve its national security.

By Robert G. Dunlop
Chairman of the Board, Sun Oil Company

"The National Petroleum Council has estimated that 55 per cent of the discoverable oil in this country and 66 per cent of the discoverable gas are still in place waiting to be found."

THERE IS A PRICE WE MUST ALL BE prepared to pay if America's energy needs for the future are to be met effectively.

A part of that price is our acceptance of higher energy costs. A part is our commitment to conserving energy in use. And a part is our willingness to share the burden in achieving those environmental goals that relate to energy production and use.

For the petroleum industry, the price includes a deeper participation in public policy formulation, focusing broadly on long-range national energy needs and goals rather than narrowly on the individual issues most directly facing us.

If we are not, as a nation and as an industry, willing to pay this price, then we will indeed pay a more painful price in the years ahead in terms of economic loss and the erosion of freedom.

When all of the side issues are stripped away, the basic issue is clear: assuring a sufficient supply of energy at acceptable costs for the essential needs of this nation in the future. Contributing to the complexity of the situation is the fact that the expected very rapid rise in energy demand will require substantially more oil from abroad. If this problem were purely a matter of economics, we would simply draw our supplies from domestic and foreign sources on the basis of efficiency and economy. Unfortunately, however, the political instability of many foreign producing nations raises grave questions about free access to foreign supplies in the future. So our problem really is searching for that delicate balance of domestic and foreign supply that will meet our needs at the lowest costs without endangering our national security.

The dilemma is not new. It has been building for more than 20 years. But now there is a new urgency compounded of a continuing decline in domestic reserves, a steady rise in petroleum demand and a growing uncertainty about the dependability of foreign oil. For these reasons, we stand today at a crossroads, faced with the task of developing energy policies that will serve the best interests of this nation and its people in the long haul.

My thesis is simple: To assure this nation the energy it needs for the future, we must halt the trend toward public decision-making on energy matters and permit market forces to operate with the maximum degree of freedom consistent with national security requirements.

Well do I recognize that the economic measures identified this fall for implementation by our National Government run counter to this proposition. I fervently hope, however, that they will be of limited duration, for protracted interference with the free market can only have disasterous consequences.

The United States has a wealth of energy resources yet to be developed. The National Petroleum Council has estimated that 55 per cent of the discoverable oil in this country and 66 per cent of the discoverable gas are still in place waiting to

be found. The problem is a lack of incentive and capital to find and develop the resources at a rate commensurate with rising use.

Our failure as a nation to recognize that capital and cost considerations are at the base of the energy supply problem has led to some very damaging public decision-making in the past, and could lead to even more harmul decisions in the future.

The most outstanding example of such counter-productive interference with the market is the Federal Government's regulation of natural gas prices, in effect since 1954. The substitution of administrative regulation for market forces has severely curtailed the development of new natural gas reserves and has led to a grim supply outlook for the future.

Under present policies, the National Petroleum Council foresees potential gas demands rising to 38.9 trillion cubic feet in 1985 while supply declines to 21.5 trillion cubic feet—leaving a deficit of 17.4 trillion cubic feet.

Hopefully, future actions of the Federal Government's new Price Commission will not negate price increases authorized by existing regulatory agencies. If so, the shortage will become even more critical.

Public pressure on market forces in oil pricing has been less direct, but nonetheless damaging to the economic climate in which our industry operates.

A case in point is the review by the Office of Emergency Preparedness of last December's modest increase in crude oil prices. Apparently sufficient justification for the increase was found, for no action was taken.

The *fact* is that in the face of sharply rising costs the real price of crude oil has been declining since 1948. Expressed in 1958 dollars, the price was down from $3.27 a barrel in 1948 to $2.35 last year, a reduction of 28 per cent.

I am not saying that higher prices are a complete solution to our problems. But I am saying that we will not do a good job of stimulating the development of our domestic energy resources until we permit oil and gas prices to respond to market forces.

I am well aware that higher energy prices would be a bitter pill to swallow, for they have serious implications for current public efforts to achieve other priority goals. For example, there is no question but that higher oil and gas prices will make the control of inflation much more difficult in the short run. But in the long run, there is literally no alternative if we are serious about maintaining enough domestic energy supplies to meet essential needs in emergencies.

In the current review of petroleum policies which the Federal Government is undertaking, the assessment must not stop

continued

"The substitution of administrative regulation for market forces has severely curtailed the development of new natural gas reserves."

with domestic policy considerations, but must cover also our use of foreign oil. Without doubt, the import control program is the most controversial of all oil policy issues. It has been the center of heated debate since the inception of mandatory controls in 1959, and it is my impression that the rhetoric gets more intense with each passing year.

The controversy is understandable, for unrestricted use of lower-cost foreign oil has undeniable appeal for a country that is beginning to feel the impact of rising energy costs. But cost is only one consideration. We need to dig deeper to assess the role of foreign oil in the total U.S. energy picture.

The objective of the oil import control program is simply to protect the national security position of the United States, insofar as that security relates to petroleum energy. This program has been implemented in the past by limiting the volume of imports in order to sustain a viable domestic industry capable of providing sufficient petroleum to meet our essential needs. The program has thus supported a domestic price structure that, in turn, has served as an incentive for the development of domestic reserves.

There are divergent views on the question of how effectively the quota program is achieving that objective.

On balance, I say yes, it has been reasonably effective. By limiting reliance on foreign oil and promoting development of U.S. reserves, the program has enabled the United States and its allies to weather emergency situations such as the 1967 Suez crisis without suffering shortages in energy supplies. By helping to maintain stability in the domestic industry, the program has encouraged modest research and development activity in relation to synthetic fuel resources. Sun's Athabasca tar sands venture is a case in point.

But the oil import control program has run into problems along the way, too, making administration increasingly complex. The many side issues steadily broaden the program's involvement in matters which have little if anything to do with national security. Perhaps even worse, the problems are resulting in a growing divisiveness among all parties concerned.

These controversies will be intensified in the future as we become increasingly dependent on foreign oil. Projections indicate that domestic demand for liquid oil products will rise a bit less than four per cent annually from now until 1985. Domestic supply, on the other hand, will not quite hold its own in volume. The result is that by 1985 increased imports will have to make up the difference, accounting for 57 per cent of the total oil used in the U.S. and 25 per cent of the total energy (oil, gas, coal, etc.) consumed.

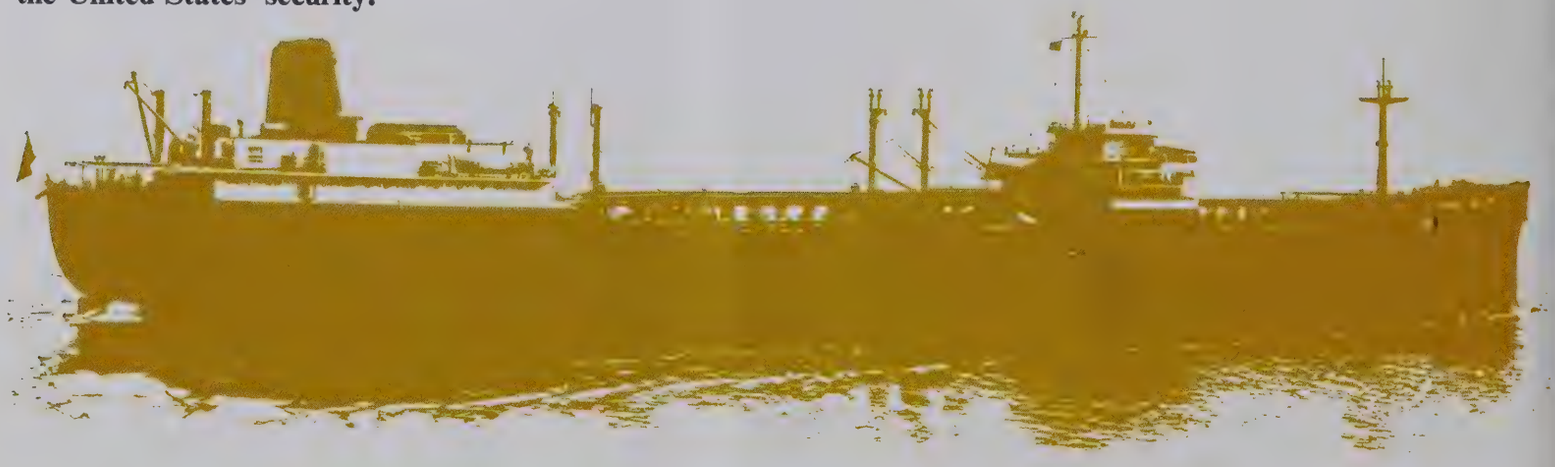
Thus, I think we must give specific attention to reappraising the present program and evaluating alternative approaches so as to assure that we have the system that will best serve the future interests of the American people. We are engaged in this very effort at Sun. But assessment must be carried out in terms of specific criteria. Among the most important of these, in my opinion, are the following:

- The program must contribute to the security position of the nation by limiting the volume of imported oil.
- It must limit this volume by a flexible means.
- It must strengthen incentives for the development of domestic energy resources.
- It must provide that the differential value of imported oil accrue to the public interest as equitably and fully as possible.
- It must contribute to the objective of assuring essential supplies of energy at the lowest costs compatible with security goals.
- Finally, it must be market oriented to the maximum extent possible.

On the other hand, the import control program must not be a mechanism for protecting those who cannot stand on their own feet competitively or for achieving other goals unrelated to national security.

I think it is quite possible that the criterion relating to market orientation will ultimately prove to be the most important

"The import control program must not be a mechanism for protecting those who cannot stand on their own feet competitively or for achieving other goals unrelated to the United States' security."



consideration of all. The perceptive Harvard sociologist, Daniel Bell, has pointed out that the trouble with public, or non-market, decisions is that they lead to increasing conflict as people organize to shape the decision-making. When the market makes a decision, it is highly impersonal, and individuals or groups who may dislike it cannot blame someone else for making it. But when government makes a decision, government becomes the focus of criticism by those who disagree and the focus of continuing efforts to change the decision. And this is precisely what we see happening in the oil import decisions made by government.

In my opinion, we must take a fresh look at the petroleum energy issue and the related problem of imports. And our appraisal must be considered in a broader context than has been the case in the past.

We need to ponder the fact that a good deal of our current problem stems from the fact that in the past we turned away from the market to public decision-making on some vital matters. In the future, I think we would be wise to move in the other direction. And in doing so, we must recognize that this requires a commitment to live by what the market decides. Obviously, operations under the economic stabilization program will make such moves more difficult.

Another commitment we face in opting for the market is the need to operate more efficiently than our competitors, including foreign competitors. That kind of operation is the best kind of guarantee we can have of a healthy industry able to stand on its own feet in the roughest kind of competition. Herein also lies the key to increased productivity, which, if coupled with sound monetary and fiscal policies on the part of government, would obviate the necessity for the continuation of the economic stabilization program.

In the long view, I am convinced that our nation and others are approaching a time when seeking protection from energy dependence on others will be a far less important consideration than somehow obtaining the necessary energy that productive growth requires. Devising fresh methods for finding, developing and using energy resources more efficiently is still the real challenge and the real opportunity to contribute to the economic and social well-being of people in our nation and around the world.

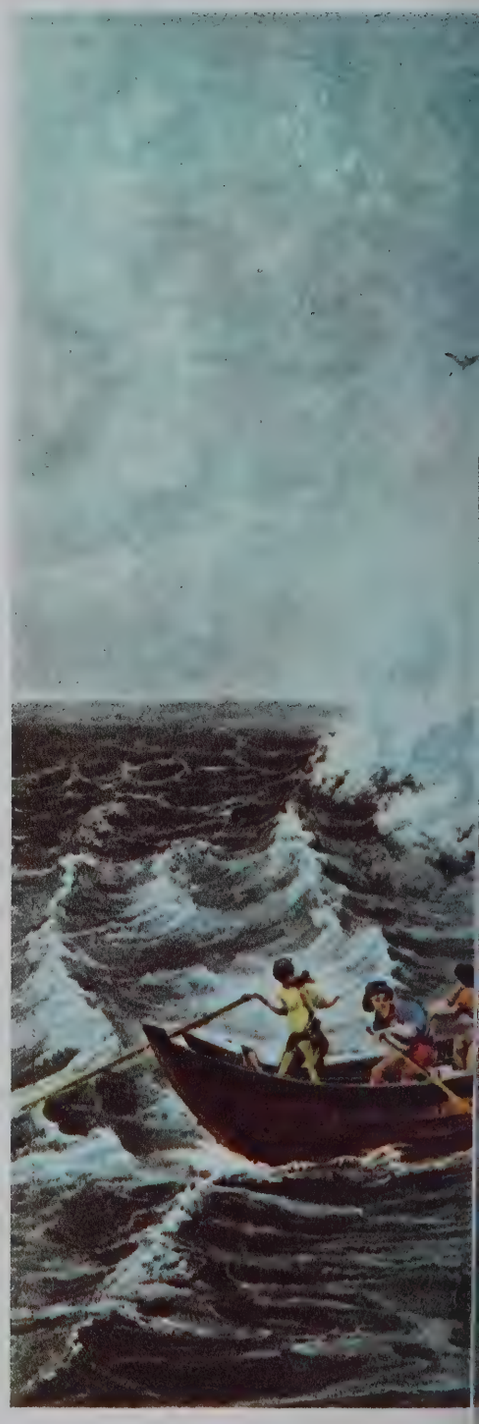
We have demonstrated frequently in the past that we have rich resources of human creativity and technical competence to meet that challenge. If we add to that mix a higher level of commitment to maintain a free market environment, I think the future energy position of our nation will be in little jeopardy. ◆

"Our problem really is searching for that delicate balance of domestic and foreign supply that will meet our needs at the lowest costs without endangering our national security."

Ban on whale oil imports sparks Sun development of synthetic sulfurized sperm oil...

Giving the Whale a fighting chance

by Bud Davis



The beauty and genius of a work of art may be reconceived, ...but when the last individual of a race of living things breathes no more, another heaven and another earth must pass before such a one can be again.

—William Beebe, 1877-1962,
American naturalist and author

I FOUND THE BOOK I WAS LOOKING FOR stuffed in the bottom of a dusty packing carton back under the eaves of the third floor: *Moby Dick,* by Herman Melville—the greatest account of whaling ever written.

I had read it about eight years ago for an English course, then packed it up with the rest of the paperbacks and moved the whole carton from place to place because you just can't throw out your old college books, even if you figure you'll never read them again.

Finally, I located the passage I was looking for—one where Melville questioned whether whales could ever be hunted to extinction. After a long discussion in which he noted the great effort it took to capture and kill a whale and the "impregnable Polar citadels" to which the whales could retreat, he concluded that the whale is "immortal in his species, however perishable in his individuality."

Unfortunately for the whale, Melville's prediction was wrong. Today, the number of blue whales—largest creatures ever to inhabit the earth—is down to less than 1,000, reduced from 100,000 at the turn of the century. "If they were left alone for fifty years or so, they might recover," says one whale expert.

Seven others species, including the sperm whale that Melville wrote about, are in danger. Thus, conservationists rejoiced when the U.S. Department of Interior placed these eight whales on the endangered species list last December. The order allowed existing importation contracts to be honored until Dec. 2, 1971, but after then, no whale products were permitted to be imported. In addition, the Department of Commerce terminated all domestic whaling licenses as of Dec. 31, 1971.

An informal survey I conducted assures me I was not alone in thinking that whaling was a thing of the past—an industry forced out of business by Drake's discovery of crude oil. Thus, I couldn't understand why it was significant that Sun Oil Company had developed a synthetic product which could substitute for the sulfurized oil of the sperm whale.

However, I soon learned a number of things about whaling in general and sperm oil in particular. Although whaling *is* nearly non-existent in the U.S., it is still a major industry in Japan and Russia. The U.S. imports about 25 to 30 percent of the world's whale oil and sperm oil production—or 200 million pounds a year, and these imports are used in hundreds of products from lubricants to lipstick and from ink to soap.

One-fourth of the U.S. whale oil con-

The hazards of early whaling are depicted in this earliest known American whaling print.

sumption is in sperm oil. This substance, like all whale oils, comes mainly from the blubber of the whale, but it is differentiated from the rest of the whale oils because of its unique chemical characteristics. (The sperm whale got its name, by the way, from the mistaken belief that the waxy solid which separates from the oil is the coagulated semen of the whale. This solid was called spermaceti, or "sperm of the whale," and thus the species became known as the sperm whale.)

In Melville's day, the raw sperm oil was used to light lamps, Now, it can be hydrolyzed, hydrogenated, epoxidized, polymerized, sulfonated, chlorinated or sulfurized for a variety of uses. The most common of these is sulfurization. Nearly half the 50 million pounds of sperm oil consumed in the U.S. is sulfurized and used as an additive in special cutting and lubricating oils.

At the time the ban on whale imports was announced, sulfurized natural sperm oil was the only known substance which could give these oils the required resistance to high temperatures and pressures. Without it, a sizeable amount of machinery in the U.S. might literally grind to a halt.

In anticipation of the ban, many researchers began looking for a sulfurized sperm oil substitute. One such scientist was Alex D. Recchuite, a young chemist at Sun Oil Company's research center in Marcus Hook, Pa.

Late in September 1970, Mr. Recchuite discovered how to make a synthetic sulfurized sperm oil. "Sun sells more than 50 products containing sulfurized sperm oil—mainly industrial lubricants—and we knew an embargo could be instituted at any time," he explained. "So our gear oil lubricants group started looking for a substitute early in 1970.

"I got involved in the project in a roundabout way. The gear oil group was testing everything on the market—unsulfurized as well as sulfurized sperm oil substitutes. I was in the research center's metal working group at the time, but the men in gear oils asked us to help out because we had more experience with sulfurization."

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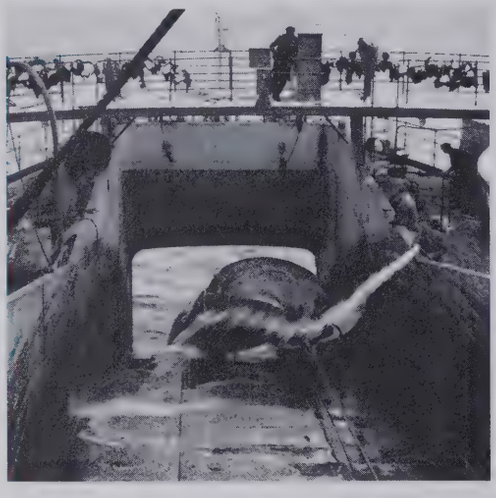


Modern whaling techniques have contributed to depletion of the world's whale population.

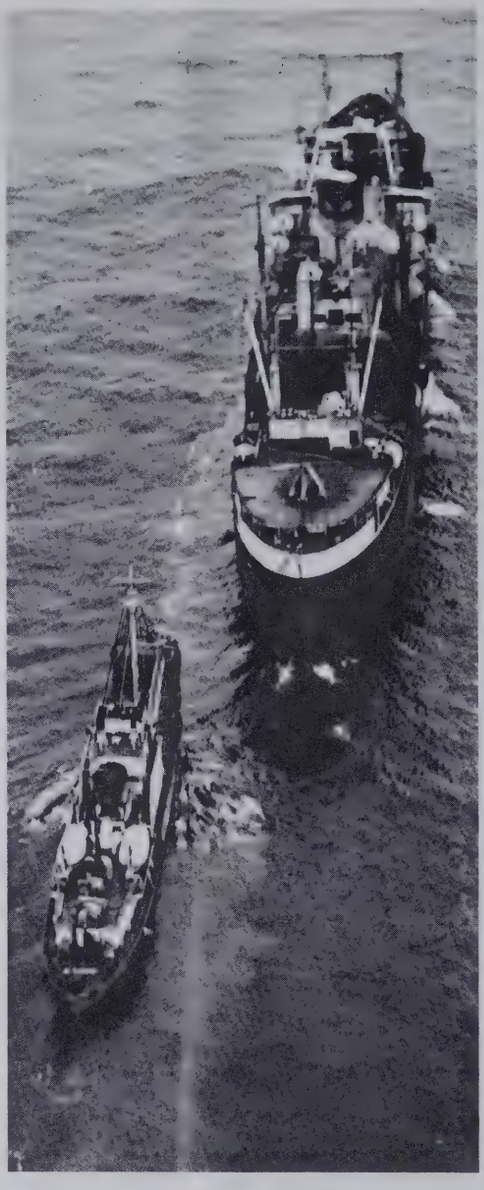
Top right: A catcher ship, with whales in tow, returns to a factory ship. Processing of whales at sea eliminates the need for returning to shore and frees the catcher to get more whales.

Top left: Modern harpoon gun—most prominent feature on the bow of the catcher ship—fires a grenade which explodes inside the whale.

Middle: Dwarfed by a modern factory ship, a whale is hoisted up a sluiceway to the deck.

Bottom: Cut-up blubber is fed through holes in the deck to pressure boilers, which reduce the blubber to oil. Other vats treat meat and bone.

These eight whales were put on the endangered species list by the U.S. Department of Interior.



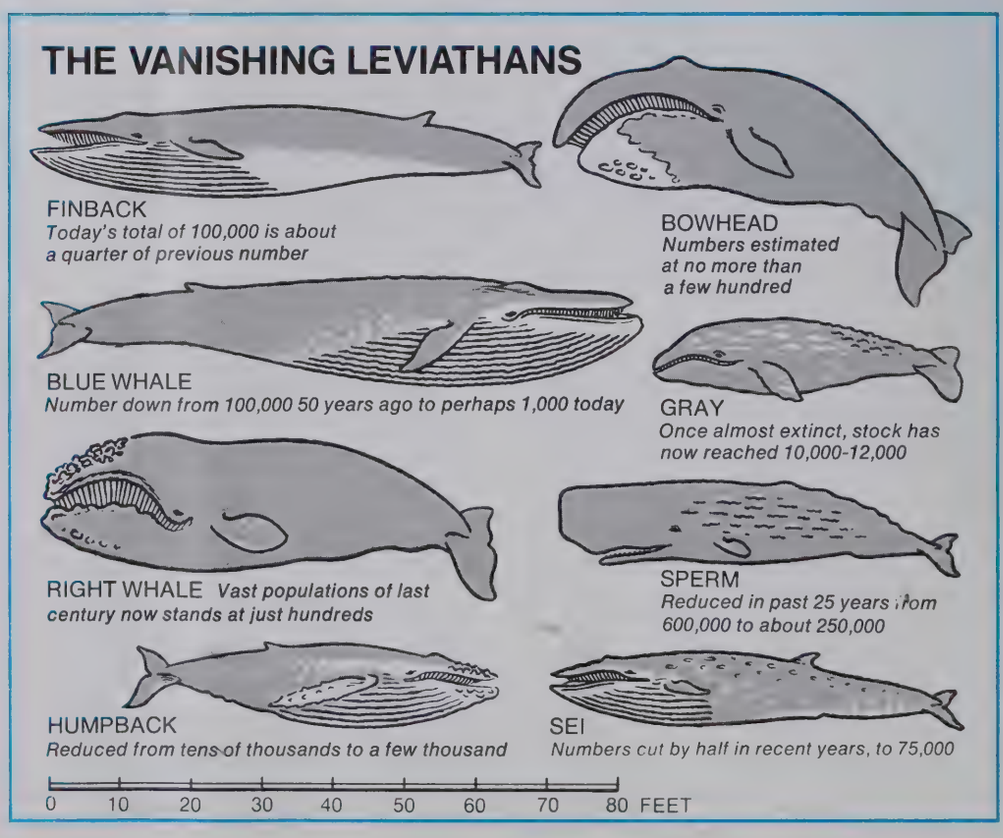
At first, all Mr. Recchuite did was sulfurize the straight sperm oil substitutes that were brought to him. But each time, he became more involved in the project. "A few of the substitutes seemed to have the right properties," he noted, "but they were very costly. Others were easily sulfurized, but would not dissolve in the base oil. Still others were very difficult to sulfurize at all."

Then one day Mr. Recchuite came up with what he calls a "harebrained idea" for a synthetic product that would be inexpensive, easily sulfurized, and soluble in a variety of base oils. With the help of his co-worker, Howard M. Rue, and his supervisor, Edward Jolly, he made some of the product and took it to the gear oils laboratory for testing. "To our surprise, it worked just fine," he recalled as though he was still surprised. "So we applied for a patent."

The process was licensed to Mayco Oil and Chemical Company, of Bristol, Pa., a firm with extensive experience in sulfurization and the ability to get the discovery into commercial production quickly.

It is now being marketed to Sun and many other firms under the trade name *Maysperm*. But when I questioned Mr. Recchuite about its composition, he said he couldn't reveal that, since the patent approval is still pending. All he would say was that the products from which it is made are far more readily available than sperm oil ever was.

Alex Recchuite's discovery came none too soon for the sperm whale. In Melville's time, the whale had a fighting chance of



getting the best of his pursuers. The main ship could go no faster than the wind would carry it, and the small whaleboats used to approach the leviathans were not much larger than a rowboat you might go fishing in.

The harpooner, who stood in the bow of the whaleboat, used only his own muscle to drive the harpoon into the whale's blubber, and the crew often went for a "Nantucket sleigh ride" when the great beast would dive to the bottom in his attempt to get away.

In 1865, however, a Norwegian named Svend Foyn invented a gun that could fire a harpoon into a whale from a distance. The harpoon had an explosive head that would detonate deep in the whale's body and cause mortal damage.

The whale's odds have been getting worse ever since. Here is how science writer John A. Barbour, in his book, *In the Wake of the Whale,* summarized the whaling industry as it moved into the twentieth century:

"The stage was set for the last, great stage of modern whaling, the stage that was to see the demise of the world's great whales under the modern weapons and techniques of man.

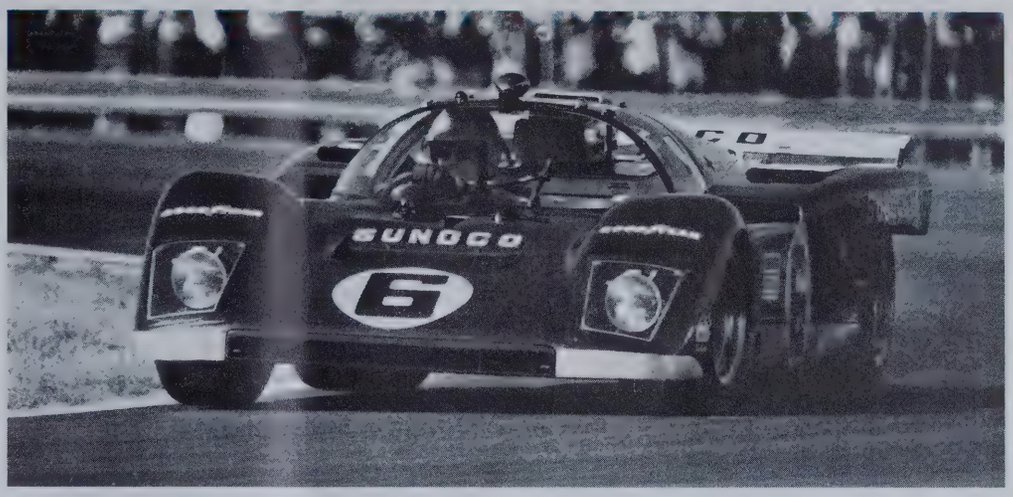
"New ships were built, powered by steam, with a bigger capacity; these were huge floating butcher shops where whales could be pulled aboard and cut up, boiled down, processed for market. Tankers would pump the oil from the factory ships and take it to home port. At the same time the catcher boats, now bigger and faster, staked out more whales and still more."

The slaughter reached its peak during the 1930s. Ironically, the only thing that saved the whales then was a war between men. After World War II, however, whaling resumed on nearly the same scale as before. Although the United States virtually withdrew from the industry, it still imported large quantities of raw whale oil and whale products.

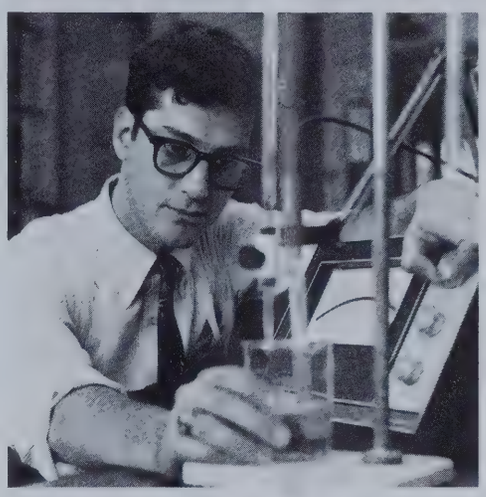
I remember my English professor saying that *Moby Dick* is more than just a story about whaling—that it is symbolic of the struggle between man and the elements and that the great white whale, Moby Dick, symbolizes all that is wild and uncontrollable in nature.

I suppose it was a good symbol at the time, but somehow today's mechanized fleets of whalers would make even Moby Dick seem like a minnow used to bait a fisherman's hook.

In the 120 years since Melville wrote the book, man has firmly established his mastery over most of nature. Inventing an inexpensive synthetic substitute for sulfurized sperm oil may seem like a minor accomplishment when set against the moon-landing headlines of today, but it is an indication that man is also learning the responsibility that accompanies his mastery of nature. ◆

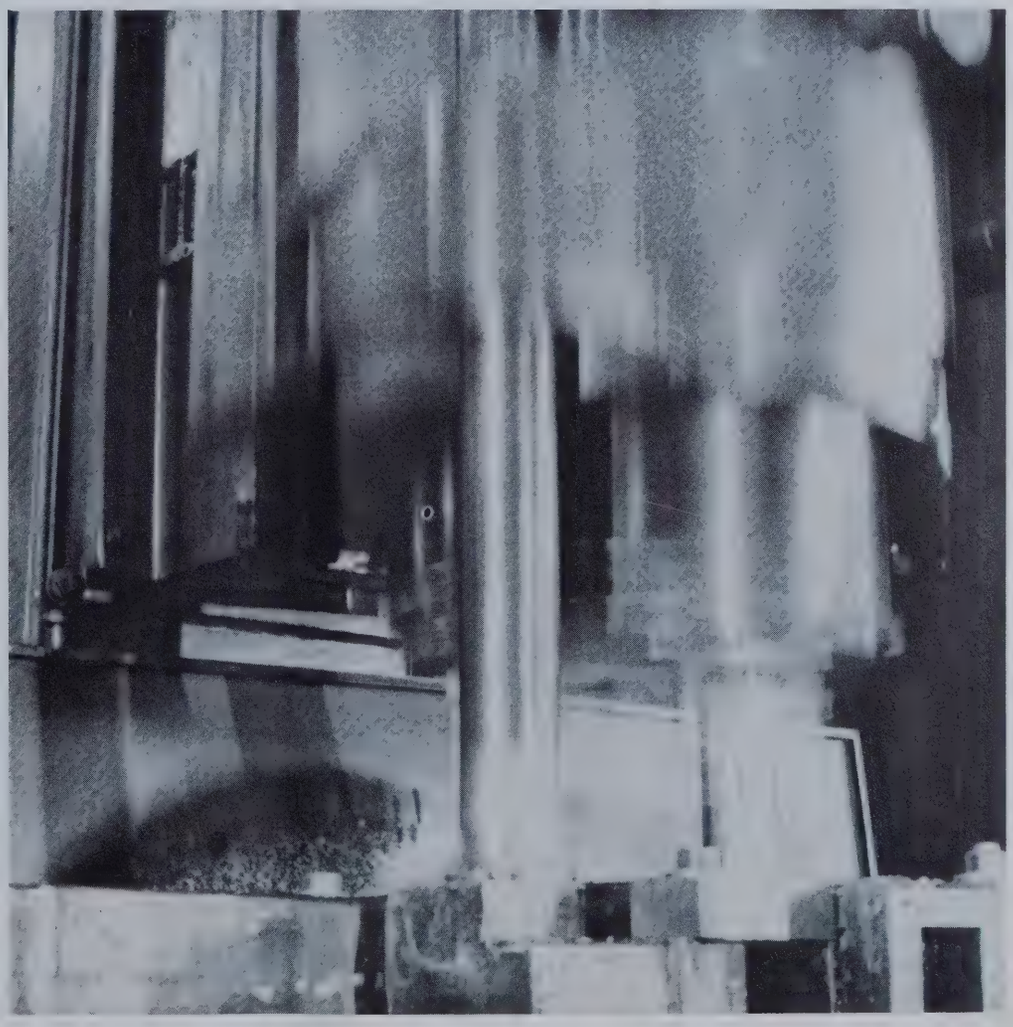


Differential gear oil—like that used in this Sunoco Ferarri driven by Mark Donohue at the 1971 "24 Hours of Daytona"—is just one of many specialized lubricants requiring an additive with the properties of sulfurized sperm oil.



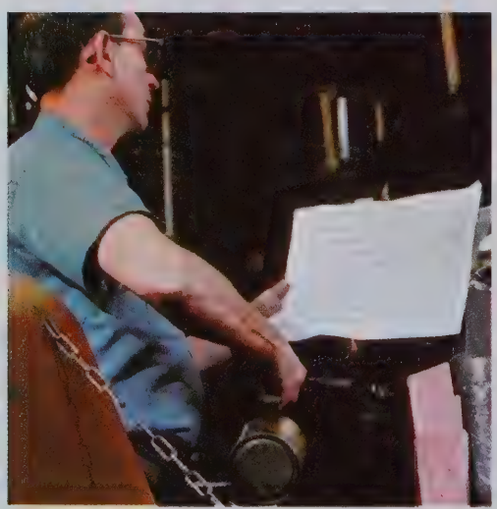
Sun chemist Alex D. Recchuite invented an inexpensive substitute for sulfurized sperm oil in response to a U.S. ban on whale products.

Metal-working machines like this need an oil that won't break down at high temperatures and pressures. Mr. Recchuite's invention, marketed by Mayco Oil and Chemical Co. under the trade name Maysperm, *is replacing sulfurized sperm oil as the all important additive.*



Prescription for a Healthy Factory

Lubrication "doctors" from Sun have a new remedy for the high cost of factory maintenance. Unlike most prescriptions, it doesn't cost the patient anything.



Sun's prescription for a healthy factory is called Computerized Lubrication Control, or CLC. Each lubrication point is recorded on computer cards (top center), and the computer prints out lubrication schedules for use by oiler technicians as they make their rounds (top left). CLC can change a daily lubrication to a weekly one, simply by calling for installation of a larger container (bottom left) that automatically feeds oil to the machine. CLC can also schedule lubrication to meet special circumstances — such as in a factory where lubrication is craft-oriented, and only crane operators, for example, are allowed to perform maintenance on their equipment (center left). A

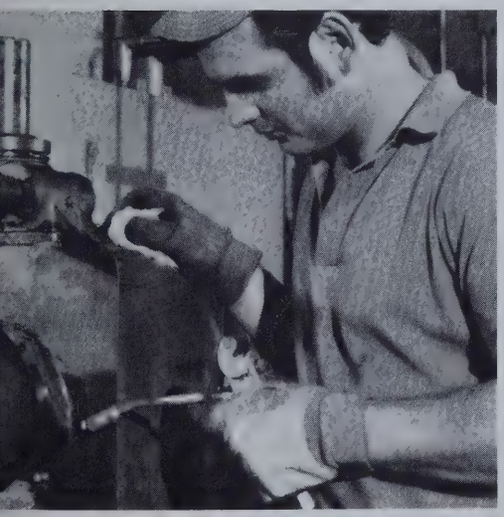
A STEEL MILL IN PENNSYLVANIA shaved 42 percent off its emergency repair work in seven months. A corn processing plant in Illinois saved almost $7,000 a year in labor and lubrication costs while eliminating equipment failures due to faulty lubrication.

A bearing plant in South Carolina cut its lubrication labor costs by 25 percent in the face of a 50 percent increase in plant size and capacity.

A transmission and axle plant in Ohio knocked 40 percent off its annual cost for bearing replacement.

What made each of these operating successes possible is a systematic approach to plant lubrication provided by Sun Oil Company. The system is called Computerized Lubrication Control, or CLC.

Sun's industrial products department makes the program available to customers who have nagging lubrication problems. Today, it is being used all across the country in all kinds of industries, including paper mills, rubber and vinyl plants, plastics molding plants, textile mills, aluminum and steel plants, bearing manufacturers and automotive plants.



large industrial plant (center right) may have as many as 50,000 lubrication points. Both production machines (top right) and plant power equipment (bottom right) require their lubrication on schedule if the factory is to be healthy.

Basically, CLC is a means of using computers to schedule lubrication work. A survey of lubrication needs is made, and this information is entered into a computer, which stores it in its memory bank.

Based on the information entered, the computer can later be programmed to supply specific lubrication work schedules in the form of computer print-out sheets. For example, management may want to separate items that require daily lubrication from those that need only weekly lubrication. Or, they may want to divide the total work load into specific segments which can be assigned to individual lubrication technicians.

Adrian G. Nussdorfer, on Sun's industrial products staff in Philadelphia, is in charge of the CLC program. He points out: "What we offer is a simple, inexpensive and flexible way to harness data processing to plant lubrication. The program can also be applied to other preventive maintenance chores that recur on a regular basis.

"Plant management is increasingly aware of maintenance activities as a potential source of profit improvement. CLC gives a manager of a large plant a much higher degree of understanding and daily control over these activities than he would have without such a program.

"Consider how a typical large plant, with some 50,000 lubrication points and perhaps 15 oiler-technicians, struggles along without computer scheduling. Some 15,000 to 18,000 lubrication record cards need periodic review and updating in order to schedule all the required activities for a given work period.

"A lubrication program of this sort becomes so massive and unwieldy, and so difficult to update that often lubrication lists are prepared only once or twice a year. Not only is file maintenance extremely expensive, but delinquency reports and rescheduling of uncompleted work are difficult to finish in time. As a result, *control* is lacking. Maintenance costs soar due to the higher incidence of equipment failure and the need for too much 'breakdown' type maintenance."

When a plant manager switches over to Sun's Computerized Lubrication Control, he can solve these problems because he has a system that his own "grass roots" people can easily learn and tailor to their plant's unique needs.

Once plant lubrication is brought under computer control, the same system can be extended into a full-fledged preventive maintenance program. Many cyclical tasks such as machinery inspections and adjustments can be properly scheduled, and this leads to longer equipment life, less downtime and improved plant profitability.

The key feature of CLC that makes all this possible is its cross-indexing capability. Because a single item may appear under several categories, it will show up on the computer print-out report if any of the categories are requested. This allows management to control and select the kind of information they want. They may, for example, want a report for a day, a week, or for an entire shut-down period.

An intangible benefit is heightened job interest among the lubrication and maintenance employees. The computer print-out job sheets have a space for comments, allowing the oiler-technicians to become an early warning team for potential problems. "Since management now can respond more quickly to their suggestions, the oilers can see faster results from the contribution they make to operations," according to Mr. Nussdorfer.

The experience in many plants shows that, once a company decides to make use of a CLC program, it derives benefits beyond the solution of its lubrication and other maintenance problems.

For example, the management of a roller bearing plant, newly located in Kentucky, finds CLC to be an excellent training tool for future maintenance technicians. Supplied with complete and accurate lists of all they have to do, new men on the job can now earn their keep while they become acquainted with the plant. Furthermore, the plant management finds that more of these men are staying on the job instead of drifting on—because they realize they have an important job to do from the moment they come to work.

CLC programming was originally designed in 1964 by Sun's computer center primarily for large indoor plants with hundreds of machine tools, or textile or paper machinery. Specific expansions have since made the program more useful to the whole petroleum and chemical processing industries. Special versions of CLC are being applied by such companies as Polymer Corporation and Union Carbide.

For the field salesmen, selling CLC is different from any other form of sales. First of all, the CLC program itself is free.

Secondly, the salesman is not selling a single product but a total systems approach to plant-wide lubrication. And thirdly, he is offering to teach plant personnel the technique of applying computer control, not only to lubrication but also to other forms of cyclic preventive maintenance.

Ordinarily, a Sun industrial products salesman would contact a purchasing agent or someone else with direct responsibility for buying lubricants. With CLC he has a story for the plant manager himself.

C. Albert Alexander, industrial products representative for Sun's Ohio Valley region, says, "It is obvious we are telling plant managers something they want to hear. Most of them are reluctant to discuss failures due to inadequate lubrication, but they all have such failures. They want to know how to control lubrication costs,

continued

bring down maintenance costs and gain greater control over operations.

"With CLC, a manager has optimum control of his plant's lubrication procedures — practically an automatic money-saving condition."

Several years ago, Mr. Alexander was contacted by the management of a large manufacturing plant in Ohio as part of the plant management's total investigation into persistent lubrication problems and resulting shutdowns. At the time, the oilermen were passing information from one to the other, frequently omitting vital data or sometimes passing incorrect information. A careful study of routing and lubricant application methods, plus feedback provided by the oilermen through the CLC work schedules, soon improved the oilermen's effectiveness.

The CLC survey also found that to properly lubricate the plant's 1,800 major machines and more than 1,000 hydraulic systems meant buying some higher-priced oils and greases. But despite these higher prices, CLC brought about a savings by reducing overall lubrication consumption by 25 percent.

CLC development expenses are minimal. Mr. Alexander estimates one man can survey 50 to 60 machines a day with the help of a Sun representative. Besides the survey costs, other setting-up expenses for CLC customers are computer time and key punching. These vary from a fraction of a minute to five minutes per day for each 1,000 machines.

In some cases, Sun's computer center has run the program for customers until they could operate it themselves. A plant with its own data-processing equipment has no problem. Others can contract with a local data-processor to have it done.

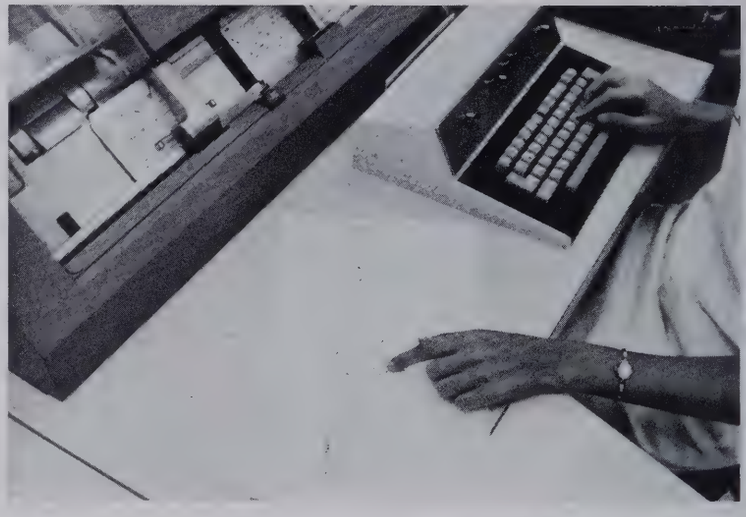
The program itself is adaptable to a wide range of industrial computer equipment. "Because of its simplicity," says Mr. Nussdorfer, "a salesman does not need a deep knowledge of computers, but he must know machinery and lubricants."

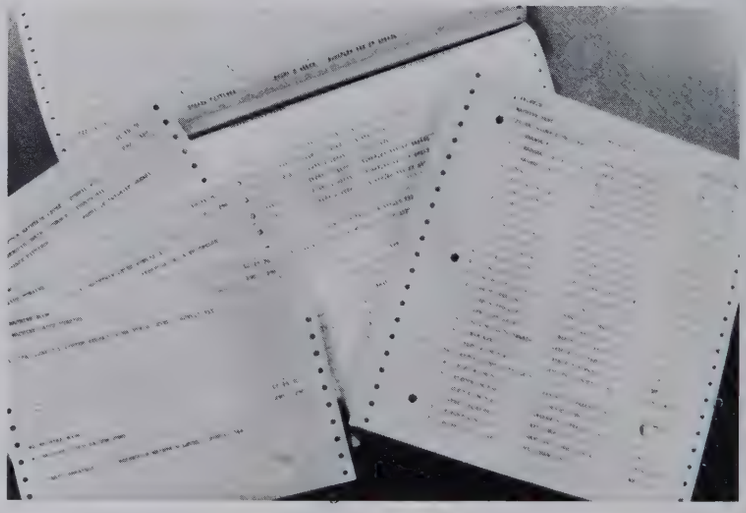
To assist the salesman in selecting correct lubricants for a great variety of applications, Sun's industrial sales department is developing a complete computer file of standard lubricant recommendations specified by original equipment manufacturers. This file will make the access to and retrieval of information easy, and this, in turn, could cut a plant's lubrication survey time in half; in some cases, only one-fourth the time will be required.

Sun Oil Company developed this program as a customer service, but of course it benefits Sun as well. CLC customers generally buy 90 to 100 per cent of their lubricants from Sunoco.

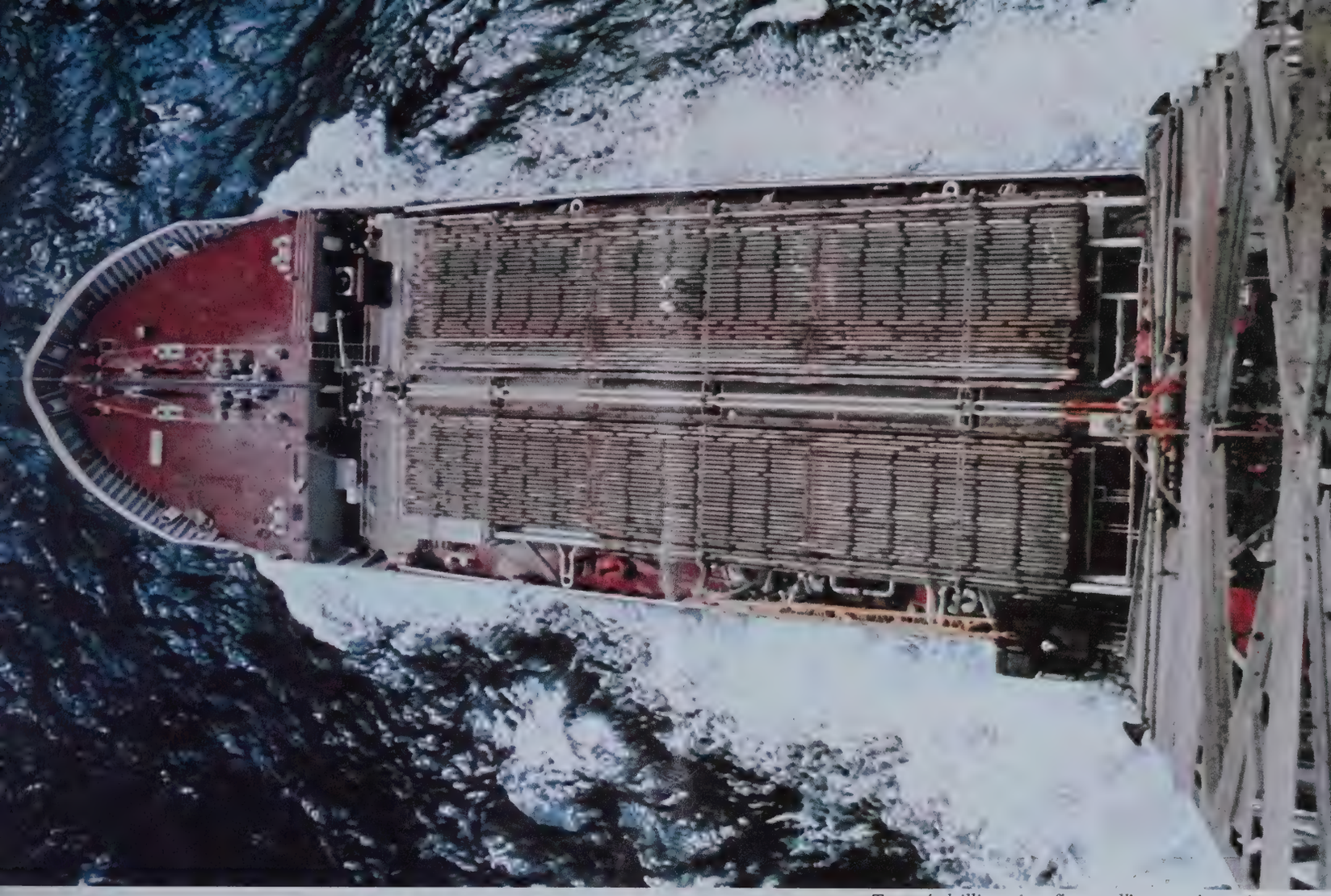
"The customer gets assurance that his machines are being lubricated at the right time with the right lubricants." Mr. Nussdorfer points out. "At the same time, CLC provides him with the possibility of developing preventive maintenance men from his oilers. Along with his purchases, he gets a service that can produce significant savings in maintenance costs and downtime within the first year of operation."

Mr. Nussdorfer sums up the CLC approach: "You get more than oil from Sunoco." ◆





A lot of planning goes into making out a prescription for a healthy factory. A lubrication routing chart (top left) is drawn up, based on the plant layout. Then a survey is taken to determine the proper lubricants and application intervals. The survey information is keypunched into a computer (top right). Also required is a lubrication manpower analysis, which is what Sun industrial products representative Adrian G. Nussdorfer is explaining to prospective customers (bottom left). The computer's final prescription can be printed out in any of three forms (bottom right)—standard computer-run paper, three-ring notebook paper, or easy-to-carry postcard-sized cards.



Top of drilling rig offers gull's eye view of drill pipe on the Challenger's *forward deck.*

SLICING HISTORY FROM THE OCEAN FLOOR

Glomar Challenger—10,500-ton research vessel—drills into ocean floor. Results will aid offshore oil technology and help geologists locate possible deep-ocean deposits of oil and gas.

by Camille J. Dawson

A UNIQUELY ASSORTED CREW OF SCIENtists and engineers has been zigzagging the oceans of the world for the past three and a half years. Their vessel: a bizarre-looking research ship called the *Glomar Challenger*. Their mission: to probe the underwater landscapes of our planet in order to learn more about the earth.

Drilling and coring into the ocean floor at various locations around the globe, the *Challenger* has completed a series of 21 cruises to date. As a result, scientists have discovered that there may be sizable reserves of oil and gas in deep offshore waters.

The *Challenger's* cruises have also shed new light upon the history of our oceans—a history found beneath the floor itself and in the tell-tale sediments of shells, silts and sands which have drifted for countless eons through the sea like a huge snowfall. Actually, to drill into the ocean floor only a short distance—often as little as a dozen feet—is to go back millions of years.

To trace the history of the sea, earth scientists joined with government, industry and educational institutions in 1966 to form the Deep Sea Drilling Project. The National Science Foundation has contributed the funds to make the project possi-

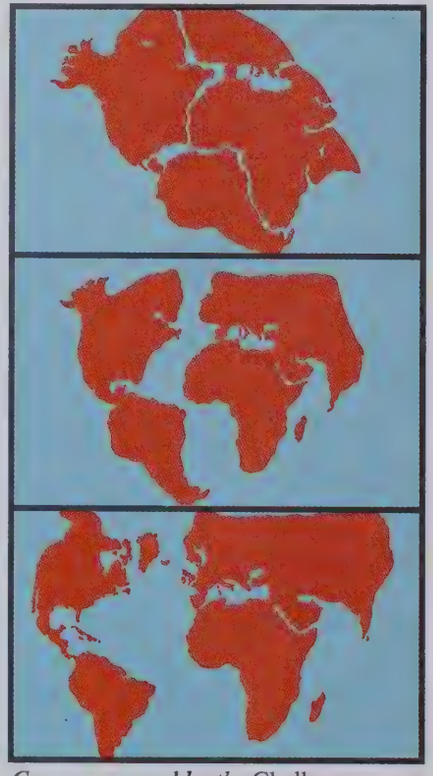
continued

ble until August, 1972. Guidance comes from the Joint Oceanographic Institutions for Deep Earth Sampling, with Scripps Institution of Oceanography, of the University of California at San Diego, as manager for the group.

The *Glomar Challenger* began her first cruise on Aug. 11, 1968, to the Sigsbee Knolls in the Gulf of Mexico. Owned and operated by Global Marine, Inc., of Los Angeles, the vessel is under subcontract to Scripps. She was named "Glomar" from a contraction of Global Marine, and "Challenger" after the first trailblazer of oceanography, the British *HMS Challenger*. The findings of that first oceanographic voyage in 1872 fill 50 huge volumes, and its core samples—cross sections of the sea floor—are still actively studied.

Today, the 10,500-ton, 400-foot *Glomar Challenger* relies on the technology of the petroleum industry to further man's fragmentary knowledge of the sea. Amidships, an oil-well-type drilling derrick tapers skyward 200 feet above the water. On board, the scientific crew, which varies from trip to trip, includes a small contingent of technical petroleum people.

This past year Thomas E. (Ed) Max-



Cores recovered by the Challenger *crew proved that oozing lava from mid-oceanic ridges causes sea-floor spreading. Samples taken from the Mid-Atlantic Ridge confirmed the theory that the continents were once joined in a huge land mass and have slowly inched apart.*

Today, scientists accept theory of continental drift and sea floor spreading. Cores recovered by Deep Sea Drilling Project reveal that world's ocean basins were formed over many million years.

well, Sun Oil Company's chief engineer for advanced operations in North American exploration and production, was on loan to Scripps for six months. Scripps had invited Sun to participate in the program and to review its personnel for candidates with offshore drilling and managerial experience. Mr. Maxwell, with a background of 17 years of petroleum engineering experience in Louisiana, Texas and Alaska, was selected. He served as cruise operations manager on two 55-day cruises, Legs 17 and 19, during which he was responsible for drilling and coring and had the final say in all operations at sea except for command of the ship.

Petroleum Engineer Maxwell joined the Leg 17 cruise in Honolulu on March 30, 1971. With 65 on board, including drilling operators, scientists and support personnel, the *Challenger* logged 4,783 nautical miles in the Central Pacific, west of Hawaii, exploring, drilling and studying core samples. "Beneath our keel stretched a corrugated bottom of mountains and trenches which have no rivals on land," says Mr. Maxwell.

The prodigious Pacific covers one-third of the globe and, in area, could swallow the seven continents. Two-thirds of the world's 600-odd active volcanoes are in the Pacific. From the Cretaceous cores (about 115 million years old) found on Leg 17, scientists found not only that lava poured out on the Pacific floor but that many undersea volcanoes built themselves up close to sea level, where reefs could flourish. "In some places," reports Mr. Maxwell, "our cores showed evidence of repeated volcanic activity millions of years after earlier outbursts."

Mr. Maxwell's second voyage, Leg 19, took him all the way from Kodiak, Alaska, to Japan by way of the Aleutians and the Bering Sea. On this leg, scientists found, among other things, that the northwesterly movement of the Pacific floor over the past 50 million years may have been only 600 to 900 miles instead of the some 2,000 miles noted by earlier studies.

As the *Challenger* cruises at 10 knots, a continuous seismic record is made. "To drill, we pick an area with a desired minimum of 300 feet of sediment cover over the first hard reflective layers," says Sun's petroleum engineer.

When the site is spotted, a sonar beacon is dropped to the ocean floor where it emits a signal every two seconds. Hydrophones under the vessel relay the signal to a computer, which in turn controls the vessel's unique positioning system. Four propulsion screws inside tunnels — one on each side of the bow and one on each side of the stern—plus the ship's two main propellers in the stern keep the *Challenger* within 40 feet of the drill-site unless the seas are very rough.

Once the ship is in position, the drill crew runs a core barrel (similar to a tubular cookie cutter), a core bit and up to four miles of drill string through a 20-by-22-foot hole in the bottom of the ship to the sea floor.

On Leg 17, a depth record of 3,887 feet was achieved when on May 2 the *Challenger* crew drilled into the crest of the Magellan Rise, located southwest of Hawaii in 10,420 feet of water.

"We drilled holes at sites from 10 to 500 miles apart," says Cruise Manager Maxwell. "Coring operations began by taking 'punch cores' in soft oozes. When the sediments firmed up, rotation of the drill pipe began. As we drilled down, we pulled core barrels containing cores and replaced them with empty barrels. Thus each barrel contained cores from different depths."

Each leg's mission is based upon taking cores; therefore, a modern core laboratory on board is necessary. Cores 2½ inches in diameter come to the surface from the ocean floor encased in a plastic liner within the core barrel. The core-filled liner is removed on deck, cut in 1½-meter lengths and sealed immediately.

Core laboratory technicians weigh each length, x-ray it and take various kinds of measurements of it. Then it is split, and the "working" half is described by sedimentologists and dated by paleontologists. Also, samples are taken for additional laboratory studies on shore.

The other half is photographed and placed in a "D" tube for refrigeration in the hold of the ship. Atlantic cores are sent to New York's Columbia University for archive storage; Pacific cores to Scripps.

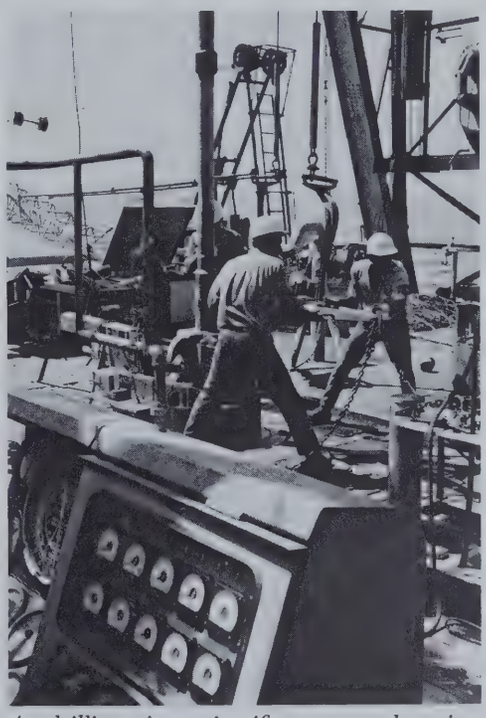
A day on the *Challenger* normally begins at 5 a.m. "Before breakfast, we radioed reports of the previous day's work back to Scripps," remarks Mr. Maxwell. "Then we ate. The food was better than in a first class hotel.

"I was constantly checking drilling operations and keeping tabs with our weatherman. We also received satellite weather and mosaics out of Honolulu." Mosaic weather information, he explains, is obtained when several patterns are put together for an overall picture of the entire Pacific.

continued

Drillers ready equipment for operation on the rig floor beneath the towering derrick. The tempo will quicken when the cores come up.

Cruise Operations Manager Maxwell (left) and Co-Chief Scientists J. I. Ewing (center) and E. L. Winterer check tungsten carbide bit.



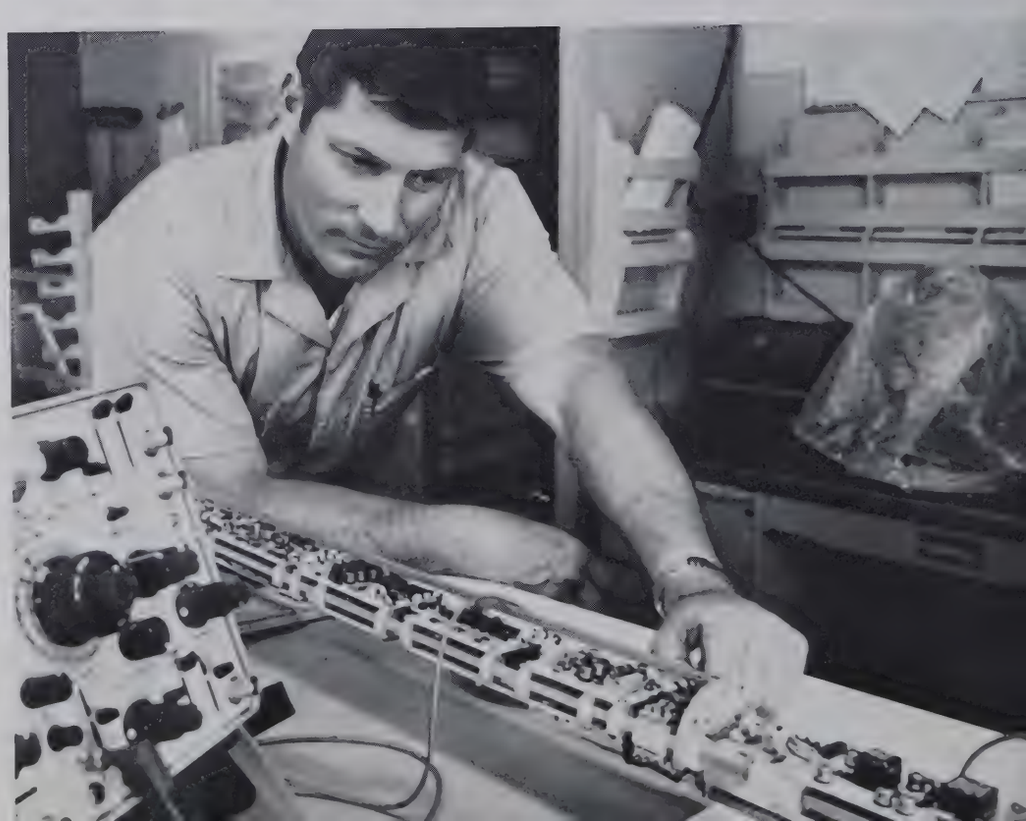
At drilling site, scientific crew and coring equipment work 24 hours a day. Roughnecks pull miles of drill string from ocean floor.

Oil rig soars nearly 200 feet above the Challenger's *waterline. Computerized positioning system, using six propellers, keeps bizarre-looking vessel on station without anchors.*

Scientist collects a soft sediment sample from tungsten carbide bit after it has been pulled up from a Pacific Ocean-bottom drilling site.

Manager Maxwell points to dark gray basalt cores recovered almost 4,000 feet under the floor of Magellan Rise, southwest of Hawaii. Co-Chief Scientists J. I. Ewing (left) and E. L. Winterer discuss the ancient specimens.

Sun's T. E. Maxwell examines electronic system of scanning sonar unit used in re-entering drill holes at previous ocean-bottom sites.



Cores are weighed, x-rayed and split in two in Challenger's *modern shipboard laboratory. One half is described by sedimentologist and dated by paleontologist. Other half is photographed, put in "D" tube and refrigerated in hold of ship for future study in U.S.*

Petroleum Engineer Maxwell, of Sun, was operations manager on two cruises. Challenger findings noted volcanic activity 100 million years ago and northwesterly movement of Pacific floor.

"We drilled 24 hours a day on location," he continues. "The crew and one of the tool pushers were always on the rig."

The tempo on the rig floor beneath the derrick changes when the cores come up. "Seeing what was in the core catcher brought real excitement," says Mr. Maxwell. "One of the co-chief scientists met every core. The paleontologist could tell immediately—from smear slides of small samples—how old the core was, what kind of sediment we were coring and whether or not it was basalt.

"Sooner or later, we wanted the cores to be basalt, or basement rock, which normally is below all sedimentary rock and contains no hydrocarbons. After we hit basement and obtained the desired samples, we pulled the drill string, secured the drill floor and moved to the next site."

Each day went quickly for Mr. Maxwell. "Before we knew it," he notes, "our cook was ready with another six-course meal. Our baker stayed up all night turning out fresh pastries." Smilingly, Mr. Maxwell recalls that the one difficult task on board was trying to ignore the pastry table near the mess hall door.

The *Challenger* is completely self-sustaining and carries enough fuel, water and stores to stay 90 days at sea. There are berthing, laundry, medical and recreation facilities for the entire crew. A full-time surgeon on board is in charge of a six-bed infirmary.

Staterooms have private baths and consist of one, two or four bunks. A bedroom steward cleans staterooms and takes care of laundry. "There was a philosophy behind all this personal attention," explains Mr. Maxwell. "Without bothering with daily menial chores, we could apply ourselves solely to our work on the project."

During work breaks, some of the men fished for yellow-fin tuna. A lucky catch, recalls Mr. Maxwell, meant fresh tuna for lunch. A favorite dinner was steak—or "lobsteer"—barbecued on the ship's fantail.

Reminiscing, Mr. Maxwell adds, "I think for so many people to be in such close confinement for 55 days, we were all remarkably congenial."

Even when the *Challenger* is cruising, there is hardly ever time for a catnap. The drillers repair equipment, and the scientific crew members write up reports, take soundings, measure seismic reflections.

Each time the ship returns to port, earth scientists have to update their information. Mr. Maxwell took a land breather during Leg 18 to write further reports and study ways of improving drilling operations before embarking on his second cruise.

How will Sun and the oil industry benefit from having a Sun petroleum engineer on Legs 17 and 19?

"We will have a much better insight into the problems of operating in deep water," says Mr. Maxwell. "Our drilling technology will be greatly improved from on-the-spot experience with instrumentation and equipment design, and with the ship's positioning system. Hopefully, this can be applied to operations Sun is anticipating in the Arctic."

Reviewing the first 19 legs, in which 298 holes were drilled, Dr. William D. McElroy, director of the National Science Foundation, terms the project "an outstanding scientific and technological success story which has put the U.S. in the forefront of deep ocean exploration."

In their search to learn more about the earth, *Challenger* scientists:

- Discovered that ocean basins are relatively young — less than 200 million years old, compared with the 4.5-billion-year-old earth and oldest dated land rocks of 3.6 billion years in South Africa.
- Recovered the oldest sediments ever taken from the ocean—160-million-year-old Upper Jurassic limestones in the Atlantic.
- Discovered metal-rich, deep-sea sediments.
- Provided additional data for interpreting deep-sea seismic information.
- Confirmed the theory of continental drift and sea floor spreading—a controversial subject since German meteorologist Alfred Wegener in 1915 advanced the idea that the continents on both sides of the Atlantic were joined once in a huge land mass which some 200 million years ago began inching apart.
- And, most important to the petroleum industry, proved that hydrocarbons exist in water far deeper than conventional theory ever indicated such deposits can form.

"Information from the drilling leads to the belief that there will be truly abundant reserves of oil and gas in the deeper offshore," says Dr. M. N. A. Peterson, acting manager for the Deep Sea Drilling Project.

The *Challenger's* drilling program has given scientists new knowledge of the earth beyond all imagination although much about the sea still remains a mystery. Each *Challenger* cruise not only gives man many of the answers to this mystery, but helps him discover even more of the questions. ◆

Kathi's "Beautification Patrol" Javelin is a familiar and welcome sight to Sunoco dealers in upstate New York and western Vermont.

Kathi gets the details of a promotion that Sunoco salesman Michael D. Schrock (left) is explaining to Interstate dealer Steve Morris.

a girl is

ONCE UPON A TIME THERE WAS AN ugly service station that lived along the highway. Everyone used him but no one liked him.

"That service station sure is ugly," people would say. Then they would fill up with gasoline and drive away.

One day, a beautiful girl came around to inspect the ugly service station. "Service station," she said, "you're pretty ugly, but I know, deep down, you're really a handsome prince. I think we can make people like you."

The service station blushed. No one had ever said anything so nice to him before. Then he looked around and saw things he'd never seen before. Like the appearance of his gasoline pumps. Sure, they did a good job, but they were smudged and the curbs on the pump island were scuffed. And his service bays. Boy, what a mess. And his rest rooms—a disgrace.

Suddenly he realized why people didn't like him. "I've let myself go to pot," he said. "I was so busy pumping gasoline and fixing cars that I never took time to spruce

The appearance of the gasoline pumps is just one of the 50 items checked by Sun's Beautification Hostesses on their visits to dealers.

Clean rest rooms rate high with customers. Dealer Walt Lincoln (right) got a very high rating for this sparkling ladies' rest room.

Pruning petunias is just one way that Sylvia Lee helps her husband Robert keep his Saratoga Springs, N.Y., station looking beautiful.

Service stations underneath Sunoco and DX diamonds are looking better than ever, thanks to beautification hostesses like Kathi Colman.

SUNOCO a diamond's best friend

up. That girl was right—I look like a bum." So the service station decided to clean up. He even planted some petunias and set up a little picnic area.

A funny thing happened after he did these things. Some of his customers started telling him how nice he looked. "You're the best looking service station I've ever seen," one of them said. "I didn't know service stations could be so good looking," said another. Other people got out their cameras and took pictures of his petunias.

Then another funny thing happened. More people started coming in to buy gasoline and other things. "Maybe, just maybe, people are starting to like me," the service station thought to himself. So he tried even harder. He kept everything sparkling clean, he painted the curbs, he cut the grass, he put up attractive banners—he did everything the beautiful girl had told him to do.

Finally, the beautiful girl came back to see him. "Oh, service station, you're beautiful," she said. "I knew you could do it!"

One of these days, that service station is going to turn into a handsome prince.

Believe the tale? Sunoco Interstate dealers do. Although none of them has seen his service station turn into a handsome prince yet, their handsome stations are attracting more and more customers. And more customers make the dealers feel like princes.

To help make this fairy tale come true, Sun Oil Company has 11 comely beautification hostesses, who regularly visit its service stations throughout much of its marketing territory. One of the girls, Kathi Colman, puts about 1,000 miles every week on her American Motors Mark Donohue-style Javelin as she checks the appearance of her 57 stations in upstate New York and western Vermont.

"Sometimes, I'll spend up to two hours with one of my dealers," she says as she heads north out of Albany on Interstate 87, her long, blonde hair blowing in the wind. "When I first started this job last March, I was afraid the dealers would resent me, but I found that they were very receptive to my suggestions. I guess they'd already seen that their sales increased if they took the time to beautify their stations."

Kathi was also afraid that the dealers wouldn't like the formal rating sheet she brought along—50 items, each worth two points. But soon there was a friendly competition among her dealers, and now they don't like it if she *doesn't* rate them.

Sun's beautification hostess program started back in 1967 as an offshoot of earlier beautification efforts. About 60 Interstate stations in Ohio were selected as a test market to find out what improvements could be made and how the dealers could be convinced to make them.

"We started with Interstate service stations because they are different from others," says Sun public relations representative Robert E. Finucane, one of those instrumental in getting the program started. "Much of their business comes from vacationers who have been driving long distances. When these people stop, they want to walk around and stretch their legs, get a soft drink, use the rest rooms.

continued

Kathi inspects the picnic area that dealer Gary Wood provides for weary travelers on Interstate 87. A spinoff effect of Mr. Wood's beautification efforts has been an improvement in the appearance of a competitor's station across the road. "I guess I was getting his customers," he says.

"The atmosphere is different, and the customer is different, so we figured we should make our service stations different, too. We urged the dealer to plant petunias around his station, grow a little grass, paint the curbs on the pump islands, keep the rest rooms spotless—make *his* station a place where *he* would be happy to stop if he were on vacation with his family."

Sun also hired Sandy Krenek, a coed from Ohio State University, as the company's first beautification hostess. "She did a fantastic job," says Mr. Finucane. "She let the dealers know she was there to help them—to increase their sales—by bringing a woman's point of view to service station marketing."

Pretty soon, gallonage started going up at the test stations. More hostesses were brought in and the program was expanded to other parts of the country. Now, three years later, all Sunoco Interstates and many DX Interstates are part of the program. Many in-town stations are also being included.

About 20 miles out of Albany, Kathi flicks on her right turn signal and exits at Ballston Lake to make her first stop of the day at Steve Morris's station. By coincidence, Michael D. Schrock, a Sunoco salesman, is also visiting Mr. Morris, informing him of a new promotion, so Kathi stays only long enough to inspect the station. (It received a 94-percent rating.)

"We work closely with the salesmen," says Kathi, "as well as with the district manager and the Interstate coordinator for the region. It doesn't take the dealer very long to know that the reason we are all there is to help him."

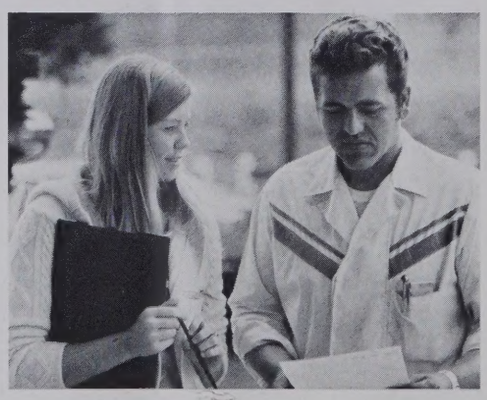
Like most of the girls in the program, Kathi has had college experience. After two years at Colby Junior College in New Hampshire and one semester at Southern Connecticut State College in New Haven, she worked in admissions at New Haven's Albertus Magnus College. This was followed by a stint at the University of Miami, where she made dean's list as an education major before returning north to take her present job with Sun.

There is little doubt that Kathi's presence is improving the appearance of the stations and the pride the dealers take in them. One of her dealers displays a town beautification award on the same shelf where he keeps his drag-racing trophies. Another carries pictures of his station with him on vacation and proudly shows them to other Sunoco dealers when he stops for gasoline.

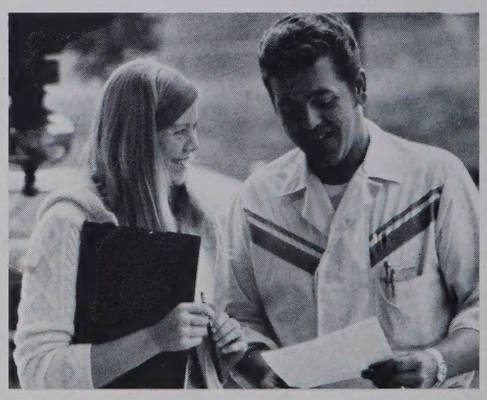
Yet another will talk for hours about beautification. "This is the greatest program going," he says. "I've had people shake my hand and congratulate me on how nice my station looks. Women have commented on the cleanliness of the ladies' room. One customer came back three times because he didn't believe a service station could look so good all the time. But we made a believer of him. My sales have been increasing right along with the favorable comments, so I guess it must be working. Besides, I like it better."

Before the day is over, Kathi will log 250 miles in her "Beautification Patrol" Javelin and visit six Sunoco stations along Interstate 87. It's a lonely job sometimes, but Kathi thinks it is worthwhile. "By helping to beautify our service stations," she says, "we are also helping to beautify America." ◆

Dealer Robert Lee shows apprehension as he gets his copy of the rating sheet . . .



. . . then disappointment at a low mark on one of the 50 beautification checkpoints . . .



. . . then satisfaction as he sees that he has scored a fine overall rating of 96 percent.

When Sun Beautification Hostesses gathered in Philadelphia last September, they came from the four corners of Sun Country, but brought a common enthusiasm for making Sunoco and DX service stations more beautiful.

Kathi is on the front car. Standing beside the rear car are Nancy Sansotta (left) and Gay Sullivan. Between the cars are (left to right) Monica Maza, Paulette Garbutt, Sandy Wilford, Linda Riccardi, Gail Higgins, Dolores North, Lisbet Cohen and Stephanie Peckham.

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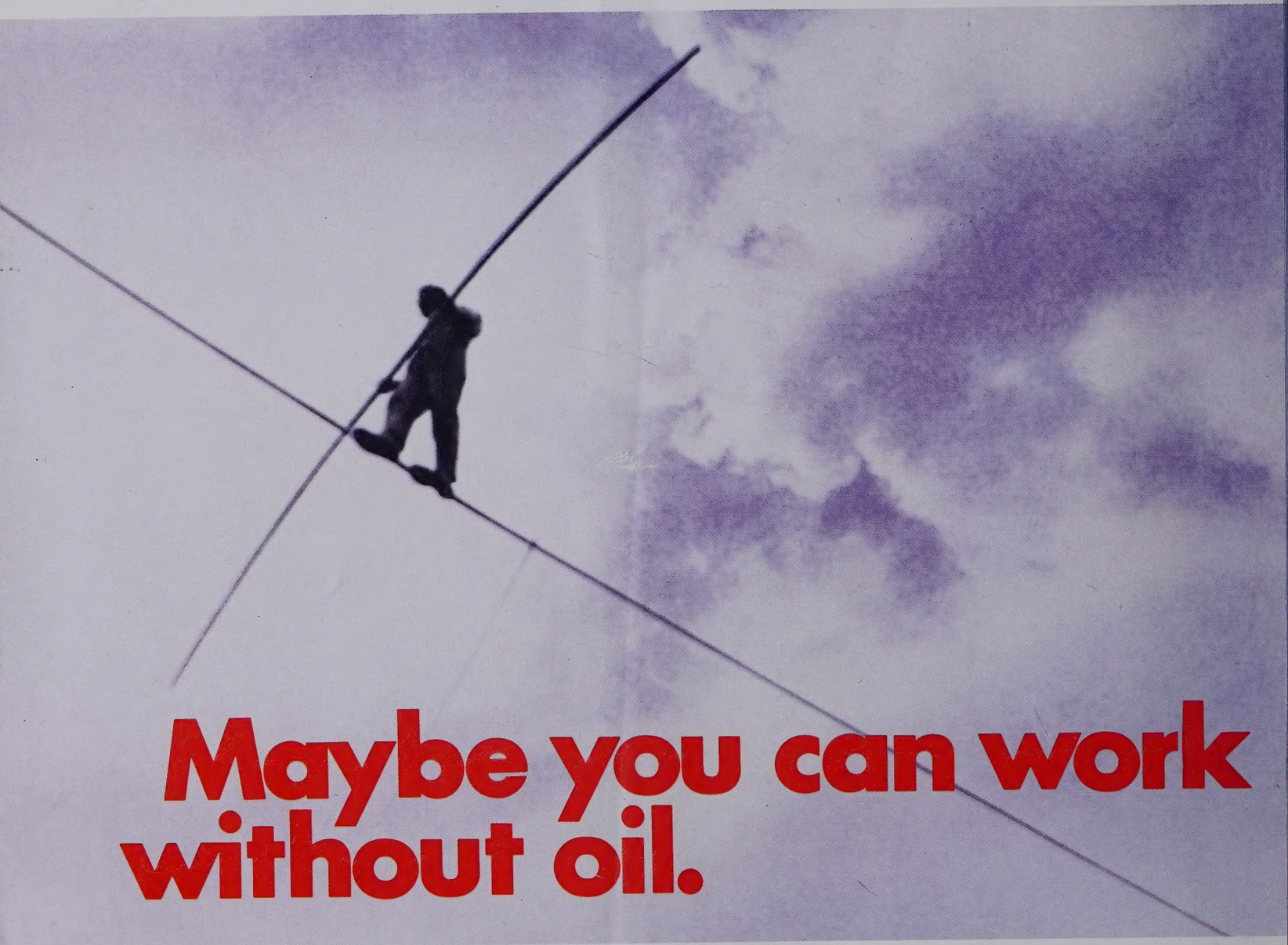

Maybe you can work without oil.

But your country can't.

What does oil have to do with your work? A great deal, of course, if you work for one of America's thousands of oil companies.

But oil is also important to everyone who drives a car to work, or rides a bus or a Diesel train

. . . and to all the people who work in industrial plants where oil and natural gas are burned to supply heat and power and in power plants that create nearly 40 percent of all our electricity

. . . all the cab drivers, truck drivers, railroad workers, airline employees

. . . all the farmers who grow our food with the help of machines that run on oil products

. . . and even the restaurant chefs and wives at home who cook with gas.

Oil and natural gas supply more than 75 percent of America's energy. Demand grows so fast that a dangerous gap is opening up between what we use and the total of new discoveries. We must search for more, even in the most rugged terrain or far out at sea.

Work without oil or natural gas? Maybe you could, but your country couldn't.

Not even tight-rope walkers. How do they get to where the tight-ropes are?